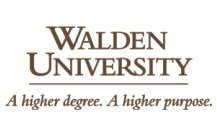

2019

Antenatal Care and Maternal Sociocultural Determinants of Childhood Immunization in Northern Nigeria

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

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2019

Abstract

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by

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MPH, University of Ibadan, 2014

MSc, University of Lagos, 2007

BSc, Nnamdi Azikiwe University, 2002

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Public Health

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Abstract

Immunization has been recognized globally as a cost-effective public health intervention. However, despite its benefits, children in northern Nigeria are still adversely affected by the negative consequences of inadequate uptake of immunization. The purpose of this study was to assess antenatal care and maternal sociocultural determinants that influence childhood immunization within 2 months of birth in northern Nigeria. Constructs of social cognitive theory were applied to this retrospective correlational cross-sectional inquiry involving women 15-49 years old in northern Nigeria. Secondary data (the 2013 Nigeria Demographic and Health Survey) were analyzed using univariate, bivariate and multivariate logistic regression. Statistically significant ($p < 0.05$) predictors of uptake of childhood immunization within 2 months of birth were the person who delivered antenatal care, the number of antenatal care visits, the number of tetanus injections, maternal educational level, religion, wealth index, husband/partner educational level, and the person who decides on health care. Educated Christian women from middle-class or rich homes, whose husbands/partners were also educated and who jointly decided on health care, made numerous contacts with health care professionals, and received at least one tetanus injection during antenatal care, had a higher likelihood of immunizing their children within 2 months of birth. The positive social change implications for this study include providing evidence of deterrents to childhood immunization that could lead to relevant policies and interventions leading to healthier children, communities, and society.

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Dedication

This degree is one of the highest points in my career and academic success. I have always dreamt of obtaining my doctorate, but at some point, with all the health and financial challenges I faced, it became a distant dream that I never thought I could attain. But here I am, hands on my computer, wrapping up my work. So, it is quite emotional and elating for me to write this dedication. I dedicate this work to my parents, Mr. Anthony and Mrs. Mabel Nzom. I am deeply grateful to God to have kept you both to witness this point of my life. My dad has always been even more excited than I am about this program and has always inquired about my progress. My mum is one of my greatest backbones, supporting and encouraging me to keep on. I have come this far in my academic life because of my parents, and I want to use this medium to thank them for being with me all the way through.

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This section affords me another opportunity to also express my gratitude to all whose efforts have led to the success of my program. I am deeply grateful to my kind-hearted husband, Mr. Eugene Ezenwa Okafor; I could not have come this far without your support and encouragement. He made many sacrifices to ensure I complete this program. I also thank my lovely and beloved children, Chibuzor, Chetanna, and Chidimma, my Walden baby. You all sacrificed the times you could have spent with me, while I studied. I also thank Elizabeth; you are like a daughter to me. I am grateful to my siblings, Buchi, Ada, Lota, and Ndu, for your concern and immense support- especially for the help you offered on the use of certain computer skills. I am deeply grateful to my parents for their financial support, and the sleepless nights my mum had to endure when I had my Walden baby so that I could turn in my discussions and assignments on time. Also, I thank my friend and mentor Dr. Henry Debem, whose support helped me achieve this. My appreciation is incomplete without mentioning my friend, sister, and confidante, Dr. (Mrs.) Ayima Lott-J, and her husband; your immense support, financial and moral, are beyond words. Thank you for being my alarm clock and much more. The academic support I received from my chair, Professor Peter Anderson, was instrumental to the success of this work. My supervisory committee members: Dr. Kai. Stewart (committee member) and Dr. Richard Palmer (URR), were awesome and very understanding; thank you. Finally, and most importantly, I am deeply grateful to our Lord Jesus Christ, whose love and faithfulness overshadows me as I count his innumerable blessings.

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Section 1: Foundation of the Study and Literature Review

Introduction

Globally, immunization is recognized as one of the most cost effective and preventive measures to reduce childhood morbidity and mortality (Gidado et al., 2014). The World Health Organization (WHO; 2018a) highlighted the benefits of immunization in preventing morbidity and disabilities and ultimately averting an estimated two to three million deaths globally each year and possibly an additional 1.5 million avoidable deaths with improved global vaccination coverage. Liu et al. (2015) related that in 2013, an estimated 6.3 million children died globally before their fifth birthday; 51.8% of these deaths were from infectious diseases, and 44% of those who died were neonates. These deaths are unacceptable because a high percentage could have been prevented through efficacious immunizations (United Nations Children's Fund, 2018).

Data from the United States also support vaccine use as one of the most effective preventive measures that have significantly reduced the incidence and prevalence of childhood vaccine preventable diseases with a resultant decline in child morbidity and mortality (Zhou et al., 2014). Whitney, Zhou, Singleton, and Schucat (2014) estimated that in the United States, between 1994-2013, routine immunizations prevented 322 million illnesses among 78.6 million children born within that period, 21 million hospitalizations over the span of their lifetimes, 732,000 vaccine-preventable deaths, a total of $402 billion in direct costs, and $1.5 trillion in societal costs. The magnitude of the health, social, and economic losses that could be averted due to immunization underpins its importance in any national economy (Abazie & Okanlawon, 2016). However, despite these statistics and the gains of immunization,

the proportion of infants and children who receive vaccinations globally has not increased such that about 19.5 million infants worldwide are still at risk of developing vaccine-preventable diseases because of different factors hindering them from receiving efficacious immunizations (WHO, 2018).

The main purpose of immunization is to prevent contagion and spread of infectious diseases. However, in Nigeria, as in many Sub-Saharan African nations, this goal has not been achieved due to many factors (Kazungu & Adetifa, 2017). Despite the obvious evidence of the capacity of vaccines to prevent diseases and reduce morbidity and mortality resulting from vaccine preventable diseases, vaccine hesitancy and lack of trust and confidence, as well as other factors, have markedly reduced immunization coverage in the country (Larson, Schulz, Tucker, & Smith, 2015).

The Expanded Program on Immunization (EPI) that was initiated by the WHO in Nigeria in 1979, with the aim of providing routine immunizations to pregnant mothers and infants under 12 months (Adegboye, Kotze, & Adegboye, 2014; Gidado et al., 2014), focused on eliminating the six childhood killer diseases: diphtheria, pertussis, tetanus, polio, tuberculosis, and measles (Ophori, Tula, Azih, Okojie, & Ikpo, 2014). Consequently, in Nigeria, the core routine immunizations proposed for infants less than 1 year of age are Bacille Calmette-Guérin vaccine (BCG), diphtheria-pertussis-tetanus vaccine (DPT), oral poliovirus vaccine (OPV), and measles vaccine (Gunnala et al. 2016). These routine immunizations are considered sufficient for infants to avoid vaccine preventable diseases.

Initially, this program, which was designed to support childhood vaccination coverage in Nigeria and prevent poor health outcomes due to vaccine preventable

diseases, was considered a success. However, there was a consistent decline in the national immunization coverage over the years. Ophori et al. (2014) reported that in the early 1990s, Nigeria recorded childhood immunization coverage of 81.5%, with a consistent drop to 12.9% by 2003. Similarly, the National Primary Health care Development Agency (2017) indicated that currently, national full immunization coverage (FIC) in Nigeria is 26% and infant immunization coverage, 17%. The continuous incidence and prevalence of these vaccine-preventable diseases underscores the fact that strategies and initiatives aimed to ensure sustained uptake of immunizations ought to be re-examined and the potential factors that influence its wide acceptance and adoption promoted (Gunnala et al., 2016).

Terrorist insurgency in northern Nigeria is another factor that has in the recent past threatened delivery and uptake of immunization and also delayed age-appropriate vaccinations (Nnadi et al., 2017; Shuaibu et al., 2016). This has been a major setback to realizing FIC in northern Nigeria because many families are unable to freely access health facilities for fear of attacks. WHO (2018a) reported that many states in northern Nigeria were inaccessible due to insurgency; consequently, health officials, escorted by combat-ready military personnel, conducted vaccination activities. Distrust of aid workers is a factor contributing to lower uptake and vaccine refusal, however. SteelFisher et al. (2015) reported the findings of a survey undertaken in northern Nigeria and Pakistan. The authors revealed that residents in high conflict areas reported lower uptake of vaccinations because of factors such as distrust, which eventually leads to vaccine refusal.

Hence, with this study, I investigated factors that influence uptake of immunization in northern Nigeria by determining if an association exists between

antenatal care and maternal factors that may influence childhood immunization uptake in the region. The results of this study could provide information on the possible maternal sociocultural determinants and features of antenatal care that promote or prevent childhood immunizations in northern Nigeria. I hope to offer recommendations that could improve childhood immunization coverage in the area. Thus, the study could serve as an evidence-based resource that relevant health actors could use to improve childhood immunization programs aimed at improving uptake in northern Nigeria, in addition to contributing guidance for future studies.

Problem Statement

Immunization has been globally accepted as a public health strategy to reduce (Gidado et al., 2014; Liu et al., 2015). However, despite global and national efforts to reduce neonatal, infant, and child morbidity and mortality due to childhood preventable diseases in Nigeria, northern Nigeria is still heavily burdened by these poor health indices, as indicated by poor immunization coverage (National Population Commission [NPC] & ICF International, 2014; Ophori et al., 2014). McGavin et al. (2018) reported that by global standards, Nigeria has exceedingly low immunization coverage, especially in northern Nigeria; hence the need for this study. Paucity of information on the low uptake of immunization in this region prompted the need for this study. To address this lack of information, I assessed features of antenatal care and possible maternal sociocultural determinants that may influence uptake of immunization within 2 months of birth in northern Nigeria.

In Nigeria, childhood immunization is one of the postnatal care services offered to mothers and their children. This health care preventive service has the potential to reduce infant and child morbidity and mortality in Nigeria (Adebiyi &

Ajani, 2017). However, in northern Nigeria, many mothers and their children do not avail themselves of this health care service, consequently leading to preventable morbidity and mortality of infants and children. McArthur-Lloyd, McKenzie, Findley, Green, and Adamu (2016) argued that residents of northern Nigeria have poor health due to their poor use of available health services and resistance to infant and child immunization, leading to high infant and child morbidity and mortality. Ophori et al. (2014) supported this report that northern Nigeria has one of the lowest rates of immunization worldwide. According to NPC and ICF International (2014), the national vaccination coverage of the six geopolitical zones was 26.9% in North Central, 14.2% in Northeast, 9.6% in Northwest, 51.7% in Southeast, 52% in South-South, and 62.5% in Southwest. These rates indicate the marked difference in immunization coverage between southern and northern Nigeria. Despite the known benefits of childhood immunization (WHO, 2018a) and poor childhood immunization coverage in northern Nigeria (Ophori et al., 2014), there is a dearth of information on components of antenatal care and possible maternal sociocultural factors that might influence uptake of immunization within this region (Abdullahi, 2018.; Adeloye et al., 2017a; Singh, Haney, & Olorunsaiye, 2013).

Vaccine-preventable diseases of infants such as polio, pertussis, diphtheria, and tetanus have been implicated in many infant deaths in northern Nigeria. Adedokun, Uthman, Adekanmbi, and Wiysonge (2017) reported that an estimated 25% of infant and child deaths could be prevented with the available vaccines. Izugbara (2014) also reported that an estimated four million neonates, infants, and children under the age of 5 die annually in Nigeria from vaccine-preventable diseases. This figure underscores the magnitude of lives lost due to lack or incomplete

immunizations. Adedokun et al. reported that globally, Nigeria is one of the 10 nations where many children with different levels of uncompleted immunizations reside. Wollum, Burstein, Fullman, Dwyer-Lindgren, and Gakidou (2016) also re-emphasized the enormity of lives lost in their report, stating that globally, 14% of all child deaths occurred in Nigeria. In spite of numerous public health campaigns, initiatives, and programs aimed at promoting uptake of immunizations, low- and middle-income nations such as Nigeria are still burdened with vaccine-preventable diseases. Forae, Uchendu, and Igbe (2014) underpinned that Sub-Saharan nations such as Nigeria persistently have recorded high childhood deaths despite the different measures to reduce the prevalence, emphasizing the magnitude of burden from vaccine-preventable diseases that negatively affects the social, economic, and health status of the nation.

In Nigeria, as in many sub-Saharan African countries, vaccines are administered through community health outreach programs or during antenatal or postnatal care visits of mothers with the child or children to closest community-based clinics or hospital settings (Ataguba, Ojo, & Ichoku, 2016). Antenatal care is preventive care administered to women during pregnancy by health care professionals or workers to prevent potential health problems and provide information on healthier choices (Abir et al., 2017; Adewuyi et al., 2018; Dickson, Darteh, & Kumi-Kyereme, 2017). Andrew et al. (2014) established that antenatal care is the key to good health for mothers and their children. However, Fagbamigbe and Idemudia (2015) reported that this service is not sufficiently utilized in Nigeria, with about one third of pregnant women not assessing antenatal care service during pregnancy.

WHO recommends that countries adhere to immunization schedules to achieve optimal coverage, particularly for infants and children, and reduce risks associated with vaccine-preventable diseases (WHO, 2018). For immunization coverage to be successful in preventing outbreaks, mothers' acceptance and adherence to vaccine-preventable disease schedules is important to sustain high coverage and avoid vaccine-preventable disease outbreaks. However, vaccine hesitancy, amongst other factors, might be a critical barrier in achieving improved immunization coverage. Gunnala et al. (2016) reported that in northern Nigeria, 50% of children did not receive vaccination due to mothers'/parents' lack of knowledge while 16% did not due to procrastination/hesitancy, 15% to poor access to immunization services, and 9% to perceived side effects.

Lack of trust and confidence in vaccines are also major determinants in parents' compliance with the routine vaccine schedule, which has been noted by WHO Strategic Advisory Group of Experts (SAGE) in their work on vaccine hesitancy (Marti, de Cola, MacDonald, Dumolard, & Duclos, 2017). Although in most parts of Nigeria, vaccination of children has no added cost to parents or families, parents have reported low confidence and lack of trust in the vaccine's potential and effectiveness of the services to prevent childhood diseases and deaths (Ophori et al., 2014). For instance, investigations in the United States by the Vaccine Confidence Working Group, a group formed to assess confidence in vaccines, suggested that parents who complied with vaccination schedules had higher confidence ratings compared to parents who did not adhere to recommended schedules (National Vaccine Advisory Committee, 2015). Fundamentally, understanding the maternal influences that promote or hinder uptake of vaccinations in northern Nigeria could

help public health workers improve measures to increase parents' confidence in adhering to vaccine-preventable disease schedules and tailor immunization coverage programs.

Purpose of the Study

The purpose of this study was to assess different features of antenatal care such as maternal immunization during antenatal care services, number of antenatal care visits; and maternal sociocultural determinants that could influence uptake of childhood immunization within 2 months of birth in northern Nigeria. In addition, the study findings might provide evidence-based information on the potential influences of childhood vaccinations in northern Nigeria. Despite national efforts at increasing immunization coverage in this region, there is still a marked regional disparity in immunization coverage (Ataguba et al., 2016; Eboreime, Abimbola, & Bozzani, 2015). Knowledge of the factors that may promote or prevent uptake of vaccines is critical to realizing the goal of avoiding and eliminating childhood vaccine-preventable morbidities and mortalities (Gualano et al., 2018), hence, the need for this study.

Research Questions and Hypotheses

Research Question 1: Is there an association between antenatal care (the timing of first antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy) and uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria?

$H1_0$: There is no statistically significant association between antenatal care and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria after controlling for respondent's checkup after delivery and baby postnatal checkup within 2 months of birth.

$H1_1$: There is a statistically significant association between antenatal care and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria after controlling for respondent's checkup after delivery and baby postnatal checkup within 2 months of birth.

Research Question 2: Is there an association between maternal sociocultural influences (highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital status, number of other wives, husband/partners educational level, and person who decides on health care) and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria?

$H2_0$: There is no statistically significant association between maternal sociocultural influences and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria after controlling for age of respondent at start of first marriage and respondents' rank among other wives.

$H2_1$: There is a statistically significant association between maternal sociocultural influences and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria after controlling for age of respondent at start of first marriage and respondents' rank among other wives.

Theoretical Foundation for the Study

I used social cognitive theory (SCT) as the conceptual framework for this study to provide insight and logical explanations of the research work. The well-known Bobo doll study of the 1960s conducted by Albert Bandura and a group of psychologists and social scientists led to development of SCT (Crain, 2015). SCT was originally known as social learning theory until the mid-1980s, when Bandura expanded the theory to involve a more holistic approach and underpin the significance of cognition in predicting human behavior (Devi, Khandelwal, & Das, 2017). SCT is one of the most widely used conceptual frameworks in the area of health behavior (Glanz, Rimer, & Viswanath, 2015). As Glanz et al. (2015) noted, SCT is the basis for many community health promotion programs that emphasize dissemination of health promoting practices.

Glanz, et al. (2015) explained that SCT is an invaluable model that stresses the impact of health behaviors on health practices. The principle of SCT is founded on the interactions between behavioral, cognitive and socio-environmental influences. Their inter-relatedness and influences on each factor, known as reciprocal determinism, underpins the construct of SCT that defines the nature of the relationships. Glanz et al., (2015) suggested that knowledge of reciprocal determinism is requisite in applying SCT to health issues. In applying SCT to this study, the different constructs of the factors could affect the likelihood that mothers would change their behavior and ensure that their children receive the necessary vaccinations. In addition, application of the constructs of SCT to this research study could highlight how different maternal factors influence uptake of immunization through the interactions between individual maternal factors such as educational level, measure of wealth

index, literacy level and social factors such as religion, ethnicity, and number of co-wives.

The constructs of personal cognitive influences on behavior, which include self- and collective-efficacy, outcome expectations and knowledge (Glanz et al., 2015), will be based on mother's confidence on the efficacy of the vaccines, and the possible positive health outcome from receipt of scheduled immunizations.

Constructs of behavioral influences such as behavioral skills, intentions, and reinforcement or punishment (Glanz et al., 2015), which support or prevent engaging in health behaviors or activities such as attendance of antenatal and postnatal services could determine the chances of receiving childhood immunization. Adopting new behaviors could produce changes in the environment and the individual because one of the precepts of this theory is that behavioral change is produced not only from experiences but by also observing actions of others and the benefits it produces (National Cancer Institute et al., 2005). Hence the constructs of cognitive and behavioral influences are fundamental to this study. Different factors such as maternal confidence in vaccine efficacy, application of features of antenatal care services (ANC) and sociocultural influences may influence uptake of childhood immunization.

The SCT model is applied in many studies that are used to evaluate outcome and behavioral changes in lifestyle. Torkan, Kazemi, Paknahad, and Bahadoran (2018) related that a significant association was obtained between nutritional behavior in pregnant women and constructs of SCT, such as self-efficacy, outcome expectations and social support. Hence, this model could serve as a foundation to assess influences of behavioral changes and be applied to mother's capability to determine uptake of childhood immunizations.

Buchanan and Pose (2012) reported the findings of a project that was conducted in Ethiopia, which applied the constructs of SCT to increase the chances of child survival through community engagement and behavioral change. The five-year project recorded huge successes that exceeded their targets such as increased immunization coverage especially for measles; increased antenatal care coverage; and improved household hygienic practices for disposal of fecal matter. The application of the constructs of SCT to the project provided explanations of the accomplishments. Adoption of new positive behaviors by vast members in the community (collective efficacy), provision of support by the different groups (social support), and dissolution of societal barriers embedded in beliefs as well as creation of conducive systems for sustainability (barriers and opportunities) were the major constructs of SCT that enhanced behavioral change.

Nature of the Study

This study was a retrospective cross-sectional quantitative study utilizing the 2013 Data setdata set from the National Demographic Health Survey (NDHS) in Nigeria. The use of the study type was mandated by the program and also served as a means to achieve results faster. Furthermore, a search on related studies indicated that cross-sectional study design was the most preferred (Kesarwani, Singh, Keshari, & Dixit, 2017; Khurana, Malik, & Arora, 2017). The fundamental aim of a quantitative research design is to test theories by investigating the association between variables of interest (Creswell, 2009). The use of this approach was appropriate for this research study because it offered the possibility of analyzing data with sufficient sample size from the population of interest at a specific point in time, as well as providing information of the existence and possible magnitude of association between

independent and dependent variables (Creswell, 2009; Hopkins, 2008). Jacob, and Ganguli, (2016) explained that cross-sectional studies typically measure the relationship between exposure and outcome. This type of study is concerned with collecting data at a point in time, hence providing information on the prevalence of an outcome (Deen, Seidlein, & Clemens 2014).

In this study, I could have considered all women within reproductive age from the six geopolitical zones in Nigeria; however only women within the ages of 15 to 49 years from northern Nigeria, comprised the study population. Women of this age range were specified in NPC (2013), as the population within reproductive age from whom individual data were collected. Secondary data analysis was conducted on the individual research questionnaire of the nationally representative Data setdata set of the 2013 NDHS, which focused on women from all the states in Nigeria. Data on maternal characteristics from a total of 22,554 women from northern Nigeria was reviewed. Descriptive statistical technique was used to describe the variables, and subsequently, inferential analysis was also used to make conclusions about an association between the variables of interest.

The independent variables for this study included:

1. Antenatal care: Features of antenatal care that were studied included the timing of 1st antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy.

2. Maternal sociocultural determinants: These included those social, economic and cultural characteristics of mothers that influence their survival, their ability to make decisions for themselves and their dependents, and general well being. The

variables that were assessed included highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital status, number of other wives, husband/partners educational level, and person who decides on health care.

The dependent variable for this study is uptake of scheduled routine childhood immunization within two months of birth. The dependent variables was explained and categorized into three levels: received no immunization; completed scheduled immunization within two months of birth; and incomplete immunization. However, a child would also be considered as having received complete immunization if the child received all vaccinations except OPV_0, to accommodate pre-term infants.

The scheduled immunizations within two months of birth as indicated by National Primary Health Care Development Agency (2017) that was used for this study included Bacille Calmette-Guérin vaccine (BCG), 1st and 2nd doses of Oral Polio Virus (OPV_0, & OPV_1), and Pentavalent vaccine (Diphtheria, Pertussis, Tetanus, Hepatitis B and Hemophilius Influenza type B).

Literature Search Strategy

In order to produce credible, recent and evidence-based literature for my doctoral study, I searched different databases with relevant articles. The Walden Library was the major site used to search for articles by topic within databases in health sciences. The databases included CINAHL & MEDLINE Combined Search, CINAHL Plus with FULL TEXT, MEDLINE with Full Text, PubMed, ScienceDirect and ProQuest Nursing & Allied Health Source. During the search, I explored related articles using single and combined key search terms to broaden the scope. In addition, I used search engines such as Google Scholar, linked to the Walden Library; United

Nations Children's Fund reports and other sites that provided information on health, such as WHO, National Primary Health care Development Agency, Nigeria and Ministry of Health, Nigeria. Lastly, some doctoral studies and dissertations from the Walden library were also reviewed during the search. Peer-reviewed publications, full-text articles and scholarly journals provided the literature for the study. Although the search was initially open-ended to garner knowledge on the subject area, there was a-five-year period restriction on the publications, to be abreast on current issues on the subject matter.

Different key search terms used were inspired by the study variables. The single and combined key search terms were: *antenatal care, postnatal care, maternal care, immunization or vaccination, immunization coverage, Nigeria, northern Nigeria, vaccine confidence, vaccine hesitancy, vaccine efficacy, infant and childhood immunization, maternal influences, maternal sociocultural determinants, infant or childhood morbidity and mortality.*

Literature Review Related to Key Variables

Population

Nigeria, named after the Niger river is regarded as the most populous black nation in the world, with a current population of about 198 million, a median age of 18.4 years, with more than 42% of the population less than 15 years old, a birth rate of 36.9 births per 1,000 and death rate of 12.4 deaths per 1,000 (Central Intelligence Agency, CIA, 2018; NPC, 2018). With geographic co-ordinates of 9°05' North and 7°32' East (CIA, 2018), Nigeria has 36 states and the Federal Capital Territory, and is divided into six geopolitical zones (South West, South-South, South East, North East, North West, and North-Central), as depicted in Figure 2. As of 2017, the World Bank

(2018) reported that Nigeria had a population growth rate of 2.6%, with a population density of 209.6 per square km. With an uneven population and land mass distribution between the geopolitical zones, Nigeria has more than 250 ethnic groups and over 500 indigenous languages, with English, Hausa, Yoruba and Igbo as the predominant languages (CIA, 2018).

WHO (2018a) related that as at 2016, Nigeria had a life expectancy at birth of 53.4, lower than 58 years recommended for WHO regions (WHO, 2015a). By 2015, Nigeria had a maternal mortality ratio of 814 per 100,000 live births, infant mortality rate of 69 per 1000 live births, neonatal mortality rate of 34.7 per 1000 live births and under-five mortality rates of 108 per 1,000 live births (WHO, 2016). Considered as a lower-middle income nation, Nigeria has a gross national income per capita of $5,680, and expends 3.7% of GDP on health (CIA, 2018; World Bank, 2018).

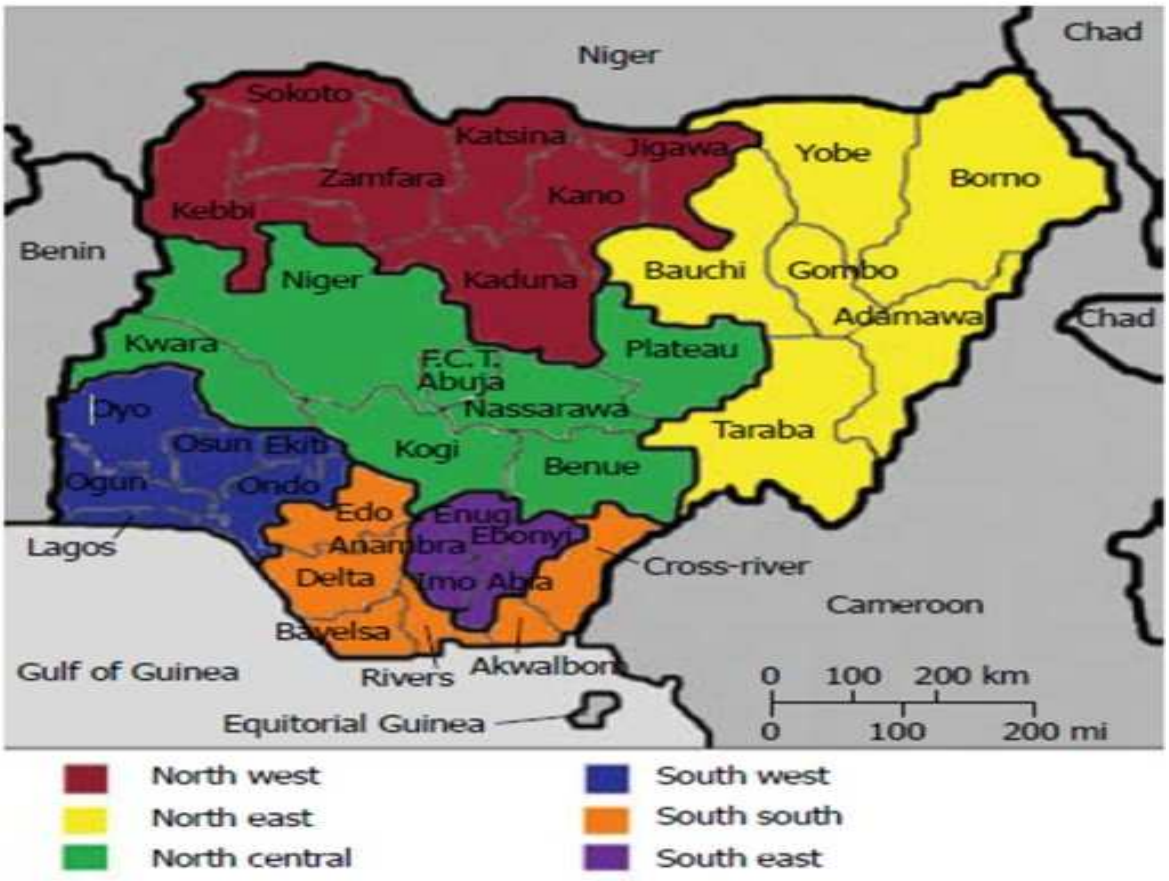

Figure 1: Map of Nigeria displaying the six geopolitical zones, 36 states and the Federal Capital Territory

Adapted from Akinlua, Meakin, Umar, and Freemantle (2015)

Global Overview of Childhood Immunization

Immunization has been recognized as an effective and cost-efficient public health intervention that would reduce and prevent neonatal, infant and childhood morbidities and mortality due to infectious diseases (Gualano et al., 2018). It is one of the strategies aimed at meeting the target of the sustainable development goal three that states *by 2030 to end preventable deaths of newborns and under-five children* (Walker, 2016). Ventola (2016) explained that the positive impact of immunizations

is experienced with a decrease in the rate of the disease and its asymptomatic state, as well as the development of herd immunity even for unimmunized children and infants. The rippling effect of this public health initiative is also experienced not only in a nation's health but also in all aspects such as its' economy and social standings, because infant mortality is the measure of national health (Abazie & Okanlawon, 2016). Hence, interventions and initiatives aimed at preventing and reducing infant and child morbidities and mortalities are fundamental to national growth (Andre et al., 2008).

Globally, one of the indicators for measuring national progress in reduction of infant and child morbidity and mortality is through the immunization coverage (Lim et al., 2017). However, despite the evident benefits of immunization, about 19.5 million infants globally still have not received necessary vaccines (Gualano et al., 2018). Ackerman and Serrano, (2015) identified some of the barriers to high vaccine coverage, such as refusal, delay, lack of trust, and confidence in vaccine efficacy. To fully harness the benefits of immunization globally, the World Health Assembly approved the Global Vaccine Action Plan in 2012 (Johri et al., 2015). However, this strategy has not fully addressed the huge inequalities that still persist within and between nations and communities.

Dunn et al., (2015) appraised vaccines as one of the greatest public health successes of the 20th century because of the economic gains and prevented deaths. One of the disparities experienced between high-income and low-income countries is the improvement of health indicators (incidence, prevalence, morbidity and mortality) for communicable diseases, necessitated by different infant and childhood immunization strategies and initiatives (Ventola, 2016). Regardless of these marked

disparities between high and low-income nations, many children in high-income nations such as the United States of America (USA) are vulnerable to these vaccine-preventable diseases. This high proportion of susceptible children in the US is because more than one in five children in the USA is incompletely immunized, lacking at least one recommended dose of the routine vaccinations (Dunn, et al., 2015). Household size, racial and economic disparities, amongst others have been identified as major obstacles to complete vaccine coverage in the USA. Similarly, Warren (2017) reported a reduction in immunization of infants in the United Kingdom (UK), which is another high income nation. The authors discovered that although the decline may not be significant, there is a nagging concern of the steady drop in immunization rates. Chief among these reasons highlighted by Warren (2017) is that few people in the U.K have not experienced the diseases being vaccinated against; hence, some families believe that they can protect their children from contracting these diseases by restricting their interaction with people. Although the vaccination coverage in the U.K is still above the recommended coverage rate of 90%, the continued drop in immunization coverage may endanger other children and threaten the herd immunity in communities free from these vaccine preventable diseases.

Awoh and Plugge, (2016) surmised that most of the lives lost due to childhood vaccine preventable diseases occur in low and middle-income countries (LMICs). Kazungu and Adetifa, (2017) reported that Africa, the continent with the highest number of LMICs, has the lowest childhood immunization coverage globally; with West African nations possessing 49% mean prevalence of FIC; underscoring the need for global efforts to tackle the threats of low immunization coverage. Johri et al.

(2015) proposed that demand for vaccine intervention is an effective strategy to improve vaccine coverage for LMICs, as well as for communities in high-income nations with poor health indicators. This strategy involves utilization of means (such as monetary incentives and communication campaigns) that stimulate the demand for vaccines, pointing to possible association between income and FIC.

Significance of Immunization in Early Infancy

The major aim of routine immunization for infants and children is to prevent and reduce mortality due to vaccine preventable diseases (Adedire et al., 2016a). The beneficial impact of immunization would be experienced globally if there were 90% coverage (Hu, Li, & Chen, 2017). Globally, about two to three million child and infant deaths would be averted with full immunization; while in Nigeria about 22% of childhood deaths that were attributed to vaccine preventable diseases would be avoided (Adedire et al., 2016; Afiong Oku et al., 2016; Uzochukwu et al., 2017). In addition, addressing the challenges to immunization delivery and uptake would significantly reduce the global burden of infectious diseases, and increase productivity and national economies. Furthermore, it would reduce the magnitude of lives lost and opportunities missed.

One of the main reasons for immunization advocacy during pregnancy is for mothers to transfer their immunities to their newborns. Orimadegun, Orimadegun, and Bamgboye (2017) reported that 41% of recorded deaths for under-five children occurred in the first 28 days of life. Bethancourt, Wang, and Bocchini, (2017) explained that vaccination of pregnant mothers is an effective protective means for mothers, fetuses and young infants from vaccine preventable diseases. Pertussis, a vaccine-preventable communicable disease, has been implicated in many newborn

deaths; thus, Kerr, Van Bennekom, Liang, and Mitchell, (2017) recommended receipt of the trivalent vaccine: tetanus toxoid, reduced diphtheria toxoid and acellular pertussis during the third trimester of each pregnancy to provide indirect protection and passive immunity for newborns threatened by the disease (Blanchard-Rohner & Eberhardt, 2017). Notwithstanding the merit of immunizing women during pregnancy and the resultant passive immunity it offers the newborn, Danchin et al. (2017) concluded that there was no association between uptake of childhood vaccinations and uptake of vaccinations in pregnancy. I examined if uptake of vaccinations in pregnancy has an impact on uptake of childhood immunizations.

Similarly, Sidhu, Dewan, and Gupta, (2016) reported the joint effort of the WHO and United Nations Population Fund in eliminating neonatal tetanus; a vaccine preventable disease responsible for 20% of neonatal deaths (Orimadegun et al., 2017). Sidhu et al. (2016) also recommended maternal vaccination against tetanus during pregnancy to protect mothers and newborns. However, this opportunity to vaccinate pregnant women may only be captured during antenatal care services; underscoring the need for this service. Adedire et al. (2016) recommended that encouraging pregnant women to attend and participate in antenatal care would improve the vaccination status of children; and consequently, increase immunization coverage. Despite the evidence of the potential benefits of passive immunity against tetanus transferred from pregnant mothers to their newborn, as established by earlier studies, there is paucity of data on the required number of vaccinations to protect the newborn. For instance, one may conclude that only one vaccination against tetanus may be sufficient in transferring immunity to the newborn. Abir et al. (2017) in their study in Bangladesh reported that neonatal death was more likely to occur in newborns whose

mothers had less than two tetanus vaccinations when compared with their counterparts who received more than two tetanus vaccinations. Although Kerr, Van Bennekom, Liang, and Mitchell, (2017b) inferred that tetanus vaccination of pregnant mothers protect newborns, the required number of vaccinations to confer passive immunity was not documented. Hence, with this study, I examined if there is an association between the number of tetanus vaccinations received by pregnant women and uptake of childhood immunization within two months of birth.

Immunization in Nigeria

Outbreaks or epidemics of vaccine preventable diseases are often associated with low or inadequate levels of immunization coverage. Soumyadeep, et al. (2015) reported that there were over 18 million incompletely immunized children globally in 2011, of which more than 50% resided in India, Nigeria and Indonesia. Kazungu and Adetifa, (2017) revealed that Nigeria had the worst percentage coverage for vaccines (BCG, DPT1-3, OPV1-3 and measles), with a correspondingly low FIC for some West African nations. Ozawa, Wonodi, Babalola, Ismail, and Bridges (2017) also reported that in Africa, Nigeria has about one million unvaccinated children; the highest number of unvaccinated children annually in the continent. Abazie and Okanlawon, (2016) also reported that 20% of these avoidable childhood mortalities in sub-Saharan Africa occur in Nigeria. Furthermore, Anya et al. (2016) reported that Nigeria is the last African nation to be removed from the list of polio-endemic nations in September, 2015; making Nigeria one of the most scrutinized nations with regards to immunization delivery, uptake and coverage.

The Nigerian government launched the Expanded Program on Immunization (EPI) in 1979, with the aim of providing the much-needed routine immunization, free

of charge to all children at the risk of contracting vaccine preventable diseases (Ataguba et al., 2016). There are 36 states in Nigeria, including the Federal Capital Territory, that receive vaccines procured by the Federal government and delivered to the states (Eboreime et al., 2015). Subsequently, the states and their local governments are responsible for delivering the routine immunization.

Ataguba et al. (2016) pointed out that the national revised policy on immunization aims to 'improve and sustain routine immunization coverage of all antigens to 90% by the year 2020'. However, until recently the immunization coverage in Nigeria is reported to be far below the anticipated rate (National Primary Health Care Development Agency, 2017), leading to 22% of annual childhood, neonatal and infant deaths (Adedire et al., 2016). Despite the different strategies to effectively deliver immunization in Nigeria, infant and childhood mortalities in Nigeria are still one of the highest globally (WHO, 2015b). Consequently, to prevent or reduce occurrence of these vaccine preventable diseases, it is pertinent that the government and all health actors prioritize strategies to improve national immunization coverage (Gunnala et al., 2016). Nearly four decades after the launch of EPI, Nigeria still struggles with the burden of infant and childhood vaccine preventable diseases, due to low immunization coverage (Ataguba et al., 2016b). The consistent poor performance in achieving the primary objective of EPI in Nigeria is because of different identified and unrecognized influences (Ophori et al., 2014).

Immunization Coverage in Nigeria

The WHO proposed a goal of 90% coverage for childhood immunization (Hu et al., 2017). This high percentage for immunization coverage is necessary to provide herd immunity against vaccine preventable diseases (Salmon, Dudley, Glanz, &

Omer, 2015). However, Oku et al., (2017) pointed out that only about 25% of vaccine eligible children are fully immunized in Nigeria; hence making it difficult to achieve herd immunity in the nation. With comparatively vast regional variations in immunization coverage (Adeloye et al., 2017); George, Erchick, Zubairu, Barau, and Wonodi (2016) concluded that Nigeria has poor immunization coverage. Gunnala et al. (2016) reported that in northern Nigeria, the median immunization coverage for three doses of DPT, OPV and one dose of BCG was less than 50%; a proportion much less than the 90% proposed national coverage (Ophori et al., 2014).

As a culturally rich and diverse nation, different factors have the potential of influencing uptake of childhood immunization in Nigeria. Oku et al., (2017) itemized some of the factors that could influence immunization coverage, such as maternal awareness that query trust and reduces confidence; safety of immunization; distance to health facilities and poor attitude of public health officers and vaccinators. George et al. (2016) also stressed the issue of accountability as one of the leading factors of low immunization coverage in Nigeria. Furthermore, Chidiebere, Uchenna, and Kenechi (2014) concluded that routine immunization coverage is poor in northern Nigeria due to factors such as cultural disparity and lack of confidence in efficacy of immunizations. Adeloye et al. (2017) and Ataguba et al. (2016) related that the lowest FIC rate and highest partial immunization coverage rates were obtained from all the northern regions of Nigeria, especially in the northwestern region. In addition, Ozawa, Zhou, Wonodi, Hui-Han, and Bridges, (2018) reported that recently, challenges of insecurity is another factor hindering immunization coverage, supply chain and vaccination demand in northern Nigeria. Likewise, mothers in northern Nigeria are opposed to the reception of immunization, thus resulting to lower uptake of

immunization in these regions (Chidiebere, et al., 2014). This marked regional differences as explained by Ataguba et al. (2016) were attributed to government mistrust and falsehoods about contaminated vaccines. The above studies focused on factors that lead to low uptake of childhood immunizations and consequently hinder FIC, especially in northern Nigeria; however, there is paucity of data on factors that positively influence immunization delivery and uptake. These factors, such as socio-cultural determinants, as explained by Eboreime et al. (2015) indicate the marked disparity in immunization coverage between northern and southern Nigeria. Consequently, I studied the maternal sociocultural factors that influence immunization uptake in northern Nigeria.

Immunization Schedule in Nigeria

Kraszewski (2017) explained that the national schedule for childhood immunization is a well-known public health intervention that requires coordinated approach by various health actors to inspire vaccine confidence and reduce hesitancy. The National Primary Health Care Development Agency provided the national immunization schedule for routine immunization in Nigeria as depicted in Figure 1. The figure stipulated BCG, Oral Polio Vaccine (OPV), Pentavalent vaccine (Diphtheria, Pertussis, Tetanus, Hepatitis B and Hemophilius Influenza type B), and Pneumococcal Conjugate Vaccine (PCV) as the vaccines to be received within two months of birth.

The National Immunization Schedule in Nigeria

Vaccine	Doses	When to give (Age)	Disease Prevention	Route of Administration	Dose	Vaccination site
BCG	1	At Birth or as soon as possible till one year	Tuberculosis	Intradermal	0.05ml	Left Upper Arm
Oral Polio Vaccine (OPV)	4	At birth and at 6, 10 and 14 weeks	Poliomyelitis	Oral	2 drops	Oral
Pentavalent	3	At 6, 10 and 14 weeks	Diphtheria, Tetanus, Pertussis, Hepatitis B and Hemophilus Influenza type b	Intramuscular	0.5ml	Left Outer Thigh
Hepatitis B	1	At birth or as early as possible within 2 weeks of age	Hepatitis	Intramuscular	0.5ml	Left Outer Thigh
Measles	1	At 9 months of age	Measles	Subcutaneous	0.5ml	Right Upper Arm
Yellow Fever	1	At 9 months of age	Yellow Fever	Subcutaneous	0.5ml	Right Upper Arm
Vitamin A	2	9 months & 15 months	Improvement of Sight	Oral	100,000IU 200,000IU	Oral
Inactivated Polio Vaccine* (IPV)	1	14 weeks of age	Poliomyelitis	Intramuscular	0.5ml	Right Outer Thigh
Pneumococcal Conjugate Vaccine (PCV)	3	At 6, 10 and 14 weeks	Pneumonia	Intramuscular	0.5ml	Left Outer Thigh
Rota***	2	At 6 and 10 weeks	Diarrhoea diseases	Oral	1.2ml	Oral

IPV*: For now at 14 weeks
Rota**: This will be introduced in the schedule by 2018

Figure 2. National Immunization Schedule in Nigeria. From National Primary Health Care Development Agency (2017).

Maternal Determinants of Infant and Childhood Immunization

There are many factors that influence uptake of infant and childhood immunization. At the individual level, maternal factors play a pivotal role in determining if infants and children receive vaccinations and/or complete the scheduled routine vaccinations (Adenike, Adejumoke, Olufunmi, & Ridwan, 2017). In a survey conducted in Nigeria, Adedokun et al. (2017) reported that maternal age is a determinant for complete immunization, as children born to older mothers are more likely to be immunized than children born to younger mothers. Hence, the chances of a fully immunized child or infant increases with an increase in maternal age. This finding may be explained by the past experiences of older mothers who may have nurtured children and learned the importance of immunization. On the contrary, Sk et al. (2018) reported that maternal age has insignificant impact on full immunization coverage. McQuaid et al. (2016) concluded that maternal age is not a determinant for vaccination of mothers during pregnancy. These diverging views by the authors provokes further research to ascertain if maternal age determines uptake of childhood immunization. Consequently, the findings from the study could describe if maternal age influences uptake of childhood immunization.

Delprato and Akyeampong, (2017) revealed that early marriage, which is predominant in northern Nigeria, is a possible deterrent of infant and childhood immunization uptake because these young girls have not reached maturity; hence, are unable to make decisions for themselves and their children. The authors explained that

delaying early marriage increased maternal tetanus vaccinations, increased number of visits for antenatal care services and doubled the chances of children being immunized.

Maternal level of education is another determinant of childhood immunization at the individual level. Adedokun et al. (2017) explained that education has a positive impact on infant and childhood immunization. Chiabi et al. (2017) corroborated this finding in their report of a survey conducted in northern Nigeria. Another maternal determinant as explained by Taiwo et al. (2017) is the socio-cultural practices in northern Nigeria that prevent women from seeking and using information about immunization. Adedokun et al. (2017) reported that mothers who had difficulties assessing health facilities were less likely to immunize their children. In some communities in northern Nigeria, the dictates of culture and religion precludes a woman from making certain decisions, some of which include seeking health care and visiting health facilities without a male escort. Thus, instances when there is absence of an adult male, the women may not immunize their children or delay the immunization. These constraints to immunization delivery and uptake would make it extremely difficult to achieve complete immunization in these regions.

At the family level, Adedokun et al. (2017) learned that child characteristics played a major role in determining immunization status of children. The authors explained that an increase in birth order reduces the probability of fully immunizing a child. Kazungu and Adetifa (2017) reported the findings of a study conducted in West African nations on vaccine coverage. Birth order was a vital determinant of full immunization; with an increase in birth order reducing the chances of full immunization

in Nigeria, Togo and Liberia (Kazungu & Adetifa (2017). This factor could be explained by income level of parents because an increased responsibility of catering for a child would reduce the available resources needed for the indirect costs of immunization; hence, possibly leading to discontinued immunization. In addition, polygamy, a common practice in northern Nigeria as in most West African nations has been highlighted as a possible determinant of childhood immunization (Lawson & Gibson, 2018). This factor as explained by Lawson and Gibson (2018) could be as a result of an increased number of adults and children who need to be cared for with limited resources. However, the authors presented conflicting reports that despite the negative influence of polygamy on child health, it may also have a positive effect with co-wives being supportive of one another. Similarly, Arthi and Fenske (2018) provided evidence that supported positive impact of polygamy in modern times and negative impact of polygamy from historical data. These conflicting reports prompt further research into the effect of polygamy on childhood immunization.

Impact of Antenatal Care on Childhood Immunization

Antenatal care is the routine health care services delivered by skilled health care professionals to presumed pregnant women and girls of childbearing age to ensure that mother and baby are in optimum health. Hence, antenatal care services as recognized by WHO have the potential to reduce maternal and neonatal morbidity and mortality through early detection and subsequent treatment of pregnancy related health issues as well as provision of information on healthier lifestyle choices (Dickson et al., 2017; Dickson, Darteh, Kumi-Kyereme, & Ahinkorah, 2018). With a high average total fertility rate of

5.7 children per woman and higher fertility rates in the northern regions as compared to the southern regions, Nigeria is expected to have high antenatal care services (McNabb, 2015); however, uptake of antenatal care is low in Nigeria. Fagbamigbe, and Idemudia, (2015) reported that Nigeria has antenatal care coverage of 61%, with one third of pregnant women not assessing antenatal care services during their period of pregnancy. Maternal death has been linked to antenatal care services, with reception of antenatal care services being protective. Fagbamigbe, and Idemudia (2015) suggested that poor maternal health in Nigeria may be a consequence of lack or inadequate assess to antenatal care services.

Bugvi et al. (2014); Wado, Afework, and Hindin (2014) reported that antenatal care services were found to promote childhood vaccination. Restrepo-Méndez et al., (2016) reported that in almost all the nations were surveys on FIC were conducted, it was discovered that FIC was lowest in children whose mothers failed to attend antenatal care; Similarly, Mbengue et al., (2017) reported that children born to mothers who utilized antenatal care services and/or delivered at health facilities were more likely to receive full immunization. (Abadura, Lerebo, Kulkarni, & Mekonnen, 2015) also related that antenatal care services were a positive determinant of full childhood immunization. In addition, Tefera et al., (2018) explained that an increased number of antenatal care visits was the strongest determinant for uptake of full childhood immunization. Lakew, et al. (2015) also corroborated these reports in the study on the impact of antenatal care in the uptake of immunization in Ethiopia. The authors revealed that regular visits to health care facilities either during antenatal or postnatal care has the potential of positively

influencing uptake of childhood immunization, and consequently reducing neonatal and childhood mortalities (Dickson et al., 2017). Contrary to these reports, Devasenapathy et al. (2017) related that in developing nations, completing the stipulated number of ANC visits is not associated with a reduced risk of neonatal mortality. The seemingly conflicting reports underscore the need to understudy the relationship between ANC visits and uptake of vaccinations. In addition, the authors did not indicate the required number of ANC visits for pregnant women that would conclusively determine if infants would receive the stipulated routine immunizations within two months of birth.

Similarly, Russo et al. (2015) proposed that antenatal care service is fundamental to achieving full immunization coverage, and strengthening antenatal care services would lead to improved immunization coverage. These reports underpin the importance of antenatal care services and their positive influence on infant and childhood immunization. To improve the quality of antenatal care services and the consequent impact on newborn care, it is pertinent that the characteristics of antenatal care are well delineated and there is adequate information on the age of pregnancy when mothers sought ANC services, the preferred health personnel, place where ANC was received, frequency of visits, services delivered and information shared on possible pregnancy distress. It is also important to mention that most of these reported studies were recorded in different settings, location and time. Thus, I provided an in-depth examination of the characteristics of antenatal care in relation to routine childhood immunization of infants within two months of birth in northern Nigeria. Furthermore, the information obtained could provide appreciable

evidence in the association between antenatal care and childhood immunization in this region.

Constraints to Immunization Delivery and Acceptance in Nigeria

Ackerman, and Serrano, (2015) stressed that low socioeconomic status is a major factor that prevents parents from allowing their children to receive immunization. This factor is prominent in women from northern Nigeria because lower social status of women hinder them from making decisions for themselves and their children (Vouking, Tadenfok, & Ekani, 2017). Similarly, Chiabi et al., (2017) reported that maternal educational level and father's profession affect full immunization coverage, with a higher educational level and better paternal profession having a positive influence. This is true for maternal educational level because literate mothers would have the ability to read and understand vaccination information, engage in conversations, thus, increase their awareness on the importance of immunization, while making informed decision (Chiabi et al., 2017). In addition, in Nigeria, as in many African nations, fathers are responsible for the needs of the family. Thus, with high paternal income, the indirect costs of immunization would be catered for.

Parental hesitance (Ackerman, & Serrano, 2015) and lack of confidence in vaccine efficacy have in the recent past being recognized as constraints to immunization uptake. Despite the global evidence of the efficacy of vaccines in reducing and preventing infant and childhood morbidity and mortality, vaccine hesitancy still persists (Marti et al., 2017). These constraints to delivery of immunization have been linked to factors such as possible side effects of vaccines; low risk of developing diseases;

awareness and knowledge; as well as socio-cultural and economic determinants (Marti, et al., 2017). To further buttress the issue of vaccine confidence and hesitancy, Larson et al., (2015) reported a survey on vaccine confidence and hesitancy conducted in Georgia, India, Nigeria, Pakistan and the United Kingdom to map global vaccine confidence. The authors reported 76% vaccine refusal in Kano State, northern Nigeria, when compared to other Nigerian states, a factor that was attributed primarily to low vaccine confidence. To address the issue of knowledge and awareness, Miguel et al., (2018) ; Učakar, Fafangel, and Kraigher, (2018) recommended strategies such as programs determined and managed by communities, which would integrate medical providers and professionals to deliver information, educate and increase awareness on the benefit of immunization.

Proper and adequate information is necessary for informed decisions. Suryadevara, Handel, Bonville, Cibula, and Domachowske (2015) pointed out that medical providers are the major source of vaccine information and their recommendations for vaccination may re-enforce parental confidence and reduce hesitancy. While medical providers are proponents of childhood vaccination, their attitudes may support or hinder uptake of immunization. Suryadevara, et al., (2015) reported that a proportion of medical providers indicated that they do not recommend routine immunization for some vaccines. Thus, the attitude of these medical providers could elicit vaccine hesitancy in parents and caregivers, resulting in reduced vaccine coverage. Similarly, Costa-Pinto et al. (2017) reported the findings of a survey conducted with pediatricians in Australia, where 54% of the doctors revealed that they rarely had time to explain the significance of vaccinations to parents, while of the proportion that

discussed vaccinations, 33% of the discussions were on vaccine hesitancy, while 24% was on vaccine safety. This finding stresses the need for re-assurance by medical professionals on the importance for vaccinations, while building parents' confidence on the efficacy of vaccines.

Another constraint to uptake of immunization is the strict policy on opening of vaccine vial. Many parents have been refused immunization because there were only few children available to receive the vaccines; hence the vial would not be opened till the specific number of children is complete. This action leads to missed opportunities as the parents may never return and the child or infant may never complete the required immunization. A survey conducted by Vouking, Tadenfok, and Ekani, (2017) in sub-Saharan Africa revealed 66% prevalence rate for missed opportunities. A similar limitation in immunization uptake was reported by Kagoné et al., (2018) in a study carried out in Burkina Faso. The authors stated an important barrier to the uptake of immunization is the policy of not commencing vaccination without complete number of children.

Definitions

Antenatal care: Antenatal care is the care provided to presumed pregnant women during the period of her pregnancy to ensure she delivers safely (Dixit, Dwivedi, & Ram, 2013). Also referred to as prenatal care, it is crucial and basic care provided to pregnant women (Dickson et al., 2017). It is a key indicator of sustainable development goals (SDGs) and one of the most appropriate periods in which to deliver health messages on caring for the new born and early signs of danger (Devasenapathy et al., 2017). It is also

the time to encourage mothers to ensure their children receive necessary immunizations (Dixit et al., 2013).

Childhood immunization: A practice where children receive vaccines to become resistant to certain infectious diseases (WHO, 2018c).

Maternal sociocultural determinants: Societal and cultural factors that influence mothers' health either positively or negatively. The WHO (2018b) explained the social determinants of health as the circumstances and settings in which individuals are born, grow, live, and work. The cultural determinants are potential societal features such as norms and religion that can influence mothers' health.

Assumptions

There were different assumptions that were made in this study. The 2013 NDHS is the data set that would be used for this study. The major assumption of this study is that there was optimum professionalism and efficiency during the study process. Hence, my assumptions for this data set included:

- The data set was a cross-sectional study that was conducted using a probability sampling technique to randomly determine the sample size that is truly representative of the population.
- The data management process, which includes the data collection and entry, validation, storage and information processing, was carried out efficiently and with minimal errors.
- The respondents provided accurate information of the study variables.
- The respondents willingly provided the information.

- The study variables were contained in the data set.
- The data set would be released for the study upon request.

The need for these assumptions was to highlight the importance of using a data set that was truly representative of the population so that generalizations could be made from the sample to that population. In addition, it was also necessary to make these assumptions to eliminate any threats to validity. Furthermore, these assumptions were made to state unequivocally if the study predictors has an association with uptake of childhood immunization within two months of birth.

Scope and Delimitations

This study was conducted using the individual research questionnaire of the 2013 NDHS for women aged 15-49 years in the three northern geopolitical zones, which comprise all the northern states in Nigeria. Thus, the study findings may not be generalized to women outside this age range or women of this age range in the three southern geopolitical zones comprising all the southern states in Nigeria, or in other locations outside Nigeria. Summarily, the study findings may not be generalized to any population beyond the specified individuals, location and age group. Nevertheless, it may provide explanation of the variables and serve as background information for similar populations. The delimitation of this study includes assessment of antenatal care characteristics and maternal socio-cultural determinants that may influence childhood immunization in Northern Nigeria using secondary data from the 2013 NDHS. Consequently, only the available variables selected for this study that are contained in the data set would be analyzed. Furthermore, the study is delimited to the questions in the

data set and subsequently, the information provided by the participants at the time the study was conducted.

Significance of the Study

The aim for conducting this research study was to determine if features of antenatal care and maternal sociocultural determinants could influence uptake of vaccinations within two months of birth and improve immunization coverage in northern Nigeria. The need to reduce vaccine preventable diseases, with subsequent reduction of infant morbidity and mortality prompted global concerted efforts to address the challenges to uptake of immunization. This effort as captured in the SDGs proposes to end avoidable deaths of neonates, infants and children under the age of five by the year 2030 (UNDP, 2018) by ensuring increased uptake of vaccinations.

The significance of this study would be valued in the development of policies intended at reducing infant and child morbidities and mortalities by promoting immunization coverage especially in northern Nigeria and addressing challenges of immunization uptake. To make informed decisions to tackle the challenges of poor immunization coverage and uptake of vaccines in northern Nigeria, relevant health players would need information on diverse areas such as maternal socio-cultural influences, and impact (facilitators and/or barriers) of antenatal care. Health and socioeconomic impact of morbidities and mortalities due to vaccine preventable diseases necessitates comprehensive public health preventive measures to increase uptake, improve coverage and reduce poor health outcomes (WHO, 2017).

Implications for Social Change

The implications for social change in every research should be to improve livelihood, social status and general health and well being of a population. The findings of this study could inspire re-dedication of relevant health actors to develop public health strategies that could reduce infant and childhood mortalities through ensuring uptake of immunization and widen coverage especially in the rural areas of northern Nigeria where immunization is markedly low (Gunnala et al., 2016). The potential positive social change implications of this study are that it could lead to improvements in antenatal care and maternal sociocultural factors and consequently prompt interventions that are tailored to children whose mothers are disposed to factors that prevent uptake of immunization.

With the outcome of this study, I would provide insight to maternal social, economic and cultural determinants that impede or promote uptake of vaccinations among infants and consequently channel efforts to different ways to address these influences by providing practical solutions to some maternal issues. The findings of this study could serve as bedrock for favorable policies towards achieving SDGs in Nigeria to ensure vaccine for all. It could also provide data with the potential to increase immunization coverage in northern Nigeria. Finally, at the individual and community levels, the findings of the study could prompt mothers to ensure that their children receive the needed immunization and inform the government and other relevant health actors towards ensuring that all children receive appropriate immunizations.

Summary and Conclusion

Immunization has been globally recognized as an effective strategy to attain the sustainable development goal of reducing neonatal, infant and childhood mortalities especially in Sub-Saharan African nations such as Nigeria (WHO, 2018c). The potential benefits of this public health initiative are well known and acknowledged in national economies (WHO, 2017). Albeit these health and economic gains of immunization, northern Nigeria is still plagued by the deadly and harmful impact of vaccine preventable diseases when compared to the States in southern Nigeria (NPC & ICF International, 2014).

The purpose for conducting this study was to determine if components of antenatal care, maternal sociocultural determinants and vaccine confidence could influence uptake of vaccinations within two months of birth and possibly improve immunization coverage in northern Nigeria. Some individual maternal factors such as age, and educational level have been shown to have an impact on immunization uptake, with older and better-educated women having the tendency to ensure their children receive immunization (Adedokun et al., 2017a; Chiabi et al., 2017). However, in northern Nigeria, the culture of the people prevents women from making certain decisions, even related to health. Consequently, I explored these maternal sociocultural factors that may influence immunization uptake. Similarly, although antenatal care and immunization during pregnancy have been shown to improve maternal and child health outcomes (Dickson et al., 2017, 2018; Kerr et al., 2017), different authors dispute the required number of times women should receive antenatal care, as well as an association of

vaccinations in pregnancy that would conclusively improve health outcomes (Danchin et al., 2017; Devasenapathy et al., 2017). I reviewed the 2013 NDHS Data setdata set to describe these possible factors that may influence immunization and subsequently, assess the association between componenets of antenatal care as well as different maternal sociocultural determinants that may influence childhood immunization uptake in northern Nigeria.

With northern Nigeria possessing very low immunization coverage (NPC & ICF International, 2014; Ophori et al., 2014), it is pertinent that factors that influence immunization uptake are examined. The study outcome could support actions aimed at achieving positive social change by increasing uptake of immunization and serve as evidence for policies that would address the peculiar challenges of the region.

Section 2 would focus on the research design and methodology for the study; describing the population under study, the data set to be analyzed and the data management process.

Section 2: Research Design and Data Collection

Introduction

Health experts have attributed the high proportion of infant, neonatal, and childhood mortalities in Nigeria to different factors including low immunization coverage (WHO, 2016). The observed marked difference in immunization coverage between southern and northern Nigeria contributes to these poor health indices, according to NPC & ICF International, (2014). The purpose of conducting this quantitative cross-sectional study was to examine antenatal care characteristics and maternal sociocultural determinants that may influence childhood immunization in northern Nigeria.

This section includes a description of the research design for the study and the rationale for choosing it, along with an overview of the methodology. I review sampling and data collection procedures and the plan for data analysis. In addition, I describe the management of the data set and the statistical tests I used to answer each research question. Finally, I itemize some potential threats to validity and discuss ethical considerations.

Research Design and Rationale

The research design for this study was a retrospective correlational cross-sectional inquiry with a quantitative descriptive approach. This type of study approach as explained by Creswell (2009) is used by researchers to test theories by assessing the association, if any, between independent and dependent variables. For this study, I used an existing secondary data set, from the 2013 NDHS for Nigeria, which was collected by the NPC in collaboration with USAID. The independent variables for this study were

antenatal care and maternal sociocultural determinants. I explored the following features of antenatal care: the timing of first antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy. Maternal sociocultural determinants included highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital status, number of other wives, husband/partners educational level, and person who decides on health care. The dependent variable was the uptake of childhood immunization within 2 months of birth. In addition, covariates, which are other variables that may influence the outcome variable but are not necessarily the variables of interest for the study (Creswell, 2009), included the age of respondent at start of first marriage, respondent's rank among other wives, respondent's checkup after delivery, and baby postnatal checkup within two months of birth.

I based my rationale for using a retrospective quantitative study on the dictates of the program and on similar studies (Kesarwani et al., 2017; Khurana et al., 2017). I considered the cross-sectional design used for the study most appropriate because the aim for conducting this research study was to test for associations between the independent and dependent variables. Cross-sectional studies allow for an assessment of the prevalence of the dependent and independent variables and whether they are associated; however, they are incapable of providing conclusive evidence of causality between the variables of interest (Sedgwick, 2014; Thelle & Laake, 2015). In spite of this limitation

of nonrobustness, the findings from the study could provide scientific evidence that other researchers might use in research involving more robust and advanced study designs.

I performed a secondary data analysis of cross-sectional data on women from the 2013 NDHS. The NDHS is a national household-based survey that is conducted every 5 years to provide estimates of the characteristics of the Nigerian population (NPC, 2013). The administrators of the NDHS frequently use a cross-sectional design because it can provide data from a representative subset of the six geopolitical zones at a point in time. Secondary analysis does not require primary data collection from the participants; rather, an already available data set is used (Creswell, 2009).

My rationale for conducting a secondary analysis of the existing 2013 NDHS data was the low cost, ease of data access, and time efficiency it afforded (Cheng, & Phillips, 2014; Hofferth, 2005). In addition, analyzing secondary data is widely accepted because of the use of large representative sample of the population under survey, which might not be achieved using a data set collected individually. This fact also increases validity of the study and the chances of generalizing findings to the entire population. Secondary analysis of existing data might also be a means of obtaining information of the past characteristics of a population. Another advantage of using secondary data is the confidentiality it affords to the participants, hence, reducing ethical concerns (Yiannakoulias, 2011). However, Cheng, and Phillips (2014) explained that important and relevant information might be deleted from the data set in the attempt to protect participants' confidentiality. Another fundamental limitation in the use of already existing data is the possibility of incomplete and inadequate information because the data

was collected for a different purpose; consequently, the researcher is limited to only the available variables (Creswell, 2009) and may be required to alter the research questions. Furthermore, errors or inaccuracies during data collection and entry cannot be corrected, introducing bias and threat to validity of the study.

Methodology

In the methodology for this study, I described the processes involved in data collection and management. The use of a secondary data in this study precludes observation or personal interaction with the participants such as collecting primary data through interviews or discussions. The analysis of secondary data was conducted using the individual research questionnaire of the 2013 NDHS, which focused on data from women in the six zones of Nigeria.

Study Area and Population

Nigeria has 36 states including the Federal Capital Territory, and is divided into six geopolitical zones: Southwest, South-South, Southeast, Northeast, Northwest and North-Central. With a growth rate of 2.6%, and a population density of 209.6 per square km, Nigeria has a population of about 198 million, with a birth rate of 36.9 births per 1,000 and death rate of 12.4 deaths per 1,000 (Central Intelligence Agency, CIA, 2018; National Population Commission, NPC, 2018; World Bank, 2018).

The 2013 NDHS, which is a nationally representative survey that was conducted to obtain reliable estimates of population characteristics, was used as the data set for this study. This data set contained information of a representative subset of all individuals, comprising men, women and children; nonetheless, the target populations under study

were women of childbearing age between 15-49 years in all the northern States that make up the three geopolitical zones in northern Nigeria (Northeast, Northwest and North-Central). Although a total of 38,948 women were involved in the survey, however data was reviewed and analyzed from 22,554 women, which is the population of women that were surveyed in the northern States in Nigeria.

Data Collection

To adequately answer my research questions, I explored the most recent Nigerian demographic health survey that was conducted in 2013. Thus, I did not conduct any primary data collection or recruitment of the study participants; however, the primary data collection procedures undertaken by the NDHS as contained in the NPC (2013) was studied. The data set can be assessed online; but the data can only be made available for use upon request. The initial steps for access involved registration as a user, followed by provision of personal information and a description of the intention to use the data set. In addition, I briefly described the project and the purpose for which I intend to use the data set. Upon submission and review of the form, official approval and permission was granted to access the Nigerian DHS data set. With this approval, I reviewed, retrieved and stored the required data set to ascertain that all required variables are present, as well as the data dictionary to obtain an in-depth and clear understanding of the variables of interest. The steps involved in the data retrieval are displayed in figure 3.

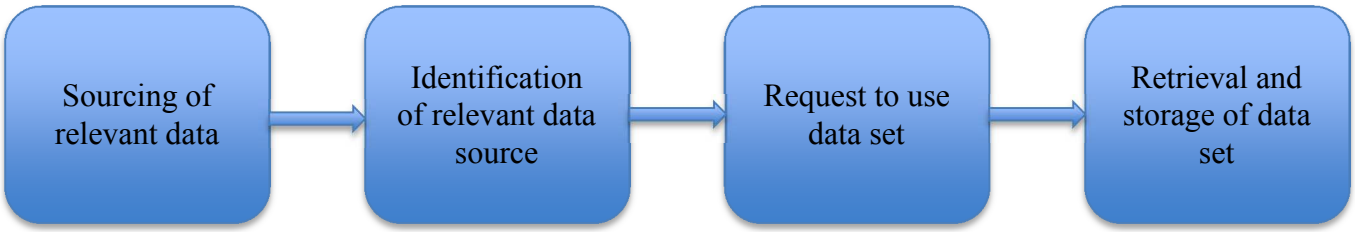

Figure 3: Procedure of data retrieval and storage.

Sampling and Sampling Procedures

National Population Commission, NPC (2013) explained that the sample for the 2013 NDHS was obtained through a stratified three-stage cluster design, which was aimed at ensuring a national representation of the Nigerian population. For proper administration, Nigeria is divided into 36 states and the Federal Capital Territory FCT. These States and the FCT are subdivided into 774 Local Government Areas (LGAs) and subsequently; the LGAs were further divided into localities. For ease and convenience, these localities were subdivided into Enumeration Areas (EAs) during the 2006 population census. These EAs were used as the Primary Sampling Units (PSUs) (NPC, 2013). The 2013 NDHS utilized these PSUs from the 2006 population census as clusters. The samples for the 2013 NDHS were then selected using the stratified multi-stage cluster design, which comprised 904 clusters with 372 in urban areas and 532 in rural areas (NPC, 2013). A total of 45 households were selected as fixed samples for each cluster; hence producing 40,680 households for the survey (NPC, 2013).

The 904 clusters, which resulted in 40,680 households that were selected for the 2013 NDHS provided a total of 38,984 women, aged 15-49. The data from this population was reviewed; however, for this study, a total of 22,554 women, the population of eligible women surveyed in Northern Nigeria, were included in the study.

Sample size. The 2013 NDHS surveyed residents of 40,680 households, comprising 38,984 eligible women (NPC, 2013). Of this population of eligible women, data from 22,554 women within the ages of 15-49 years in northern Nigeria was reviewed for this study. The sample size for this study was all women in northern Nigeria from the 2013 NDHS who met the eligibility criteria.

Rationale for the effect size, alpha level, and power level. To appropriately ascertain the sample size and to ensure it precisely identifies the outcome for this study, as suggested by Creswell (2009), I used the power analysis, which comprises the level of statistical significance or the alpha level the power level and the effect size. Mclean and Ernest (1998) explained that the rationale for using statistical significance in a study is to ensure that the outcome did not occur due to chance. This procedure is particularly relevant in interpreting data results as it establishes an association between variables. Frankfort-Nachmias, and Leon-Guerrero (2015) explained that it is this association that provides credence to rejecting or failing to reject the null hypothesis; hence, its' need in this study. The rationale for choosing the statistical significance or alpha level at 0.05 was to reduce the Type 1 error, which is the probability of rejecting the null hypothesis wrongly or when it is true (false positive) (Warner, 2012). The power level is the required force that would determine the true effect. The rationale for using the power level at medium was to reduce the Type 2 error, which is the probability of failing to reject the null hypothesis or accepting the null hypothesis when it is actually false (false negative) (Creswell, 2009). Hence the need of statistical power in this study was to correctly reject the null hypothesis or accepting the alternative hypothesis if it is true.

Having determined the statistical significance, there is a need to conclusively state the magnitude of the observed difference; hence, the need for effect size. Sullivan and Feinn, (2012) explained that effect size is the difference between the mean of two groups; it determines quantitatively the extent to which two groups differ and how this difference can be generalized to the population from where the sample was drawn. The rationale for the use of effect size at 0.5 was to ascertain the power of the conclusions between groups and associations between variables (Creswell, 2009). For all tests that were statistically significant from the results of the analysis, the effect size was calculated to ascertain the difference between the mean of two groups as suggested by Sullivan and Feinn, (2012). Finally, the use of these tests of the power analysis (statistical significance, power level and effect size) was to ensure accuracy of findings, sensitivity of the outcome and validity of results (Creswell, 2009).

The power analysis was calculated using the G*Power software 3.1 to determine that the sample size for the study was adequate to detect an effect. For this analysis, the power level was set at medium (0.8), the alpha level at 0.05 and the effect size was at 1.2 (odds ratio). The minimum sample size that would confidently power the study was determined at 1,484 participants.

Inclusion and exclusion criteria. For this study, women of childbearing age between the ages of 15-49 years were assessed in the 19 states of northern Nigeria, which are categorized into the three geopolitical zones- North West, North East and North Central zones. The inclusion criteria were all women aged 15-49 years present in the households of all the northern states of Nigeria who were either permanent residents or

visitors during the survey. The primary researchers decided on this age range because of their focus on women in their reproductive age. The major exclusion criteria were all women who were not residents or visitors of the households for all the northern States in Nigeria. Another exclusion criteria were women with missing ages. The rationale for eligibility was that this study was interested in women of childbearing age in the 19 states of northern Nigeria. Hence, any participant outside this age range and not present in the northern states was considered ineligible. Furthermore, women with missing ages may threaten the validity of the results as it may alter the age selection criterion. In addition, women within the age range who are not permanent residents or visitors of households in northern Nigeria were not be included in the study because regional differences may also threaten validity and alter the selection criterion.

Instrumentation and Operationalization of Constructs

The survey instruments (questionnaires) that were used by the 2013 NDHS was adopted for this study. The original study from NDHS obtained information using three questionnaires from men, women and household-based information (NPC, 2013) on different characteristics. These questionnaires were modeled after the original questionnaires developed by the MEASURE DHS program and subsequently modified and adapted to fit Nigeria's peculiar requirements. This survey instrument has been used in numerous studies that investigated HIV/AIDS related stigma in Nigeria; risk factors for low birth weight in Nigeria; and effect of solid fuel use on childhood mortality in Nigeria (Dahlui et al., 2015; Dahlui, Azahar, Oche, & Aziz, 2016; Ezeh, Agho, Dibley, Hall, & Page, 2014). National Population Commission (2013) reported that the

procedures involved in the data collection of the 2013 NDHS were pretested and the interviewers adequately trained.

For this study, I focused only on individual based information collected from women aged 15-49 years from states in northern Nigeria to adequately answer my research questions. Some of the broad topics from which questions were inquired included background characteristics; antenatal, delivery, and postnatal care; child immunization and childhood illness.

For quality assurance and control, I used the SPSS Version 21, which is a reliable statistical tool, to conduct my analysis. Descriptive and inferential statistical techniques were explored to ensure that I take care of missing data, outliers and also to ensure consistency.

Use of National Demographic Health Survey data. The 2013 NDHS was intended primarily to provide reliable data on population and health indices in Nigeria (NPC, 2013). The information generated from this data was invaluable for decision making in planning, monitoring and evaluating initiatives and programs that would address national health challenges.

The standard DHS survey type was used for this study. The questionnaire was the instrument that was used by the 2013 NDHS and was also the measuring instrument of choice for this study. Questionnaires are convenient means of collecting relevant and standardized data (Ponto, 2015). The variables obtained from the NDHS data set, which were generated from the questionnaires, were used to answer the research questions. The rationale for using the questionnaire, as the instrument for choice for this study was

convenience, low cost, ease of quantification and time saved (Mathers, Fox, & Hunn, 2007; Ponto, 2015).

Access to Data set. Having decided to use the data set from the 2013 NDHS, to ensure that I would assess national representation of the population, I surfed the Internet, using Google as the search engine to search for the Demographic and Health Survey. I selected the first result on 'The DHS Program- Quality information to plan, monitor and improve population, health and nutrition programs' displayed on www.dhsprogram.com/. From this page, I selected DATA and subsequently, I was directed to the data sets from different countries. I selected the most recent available Standard Demographic Health Survey type for Nigeria, which was the 2013 NDHS. As a new user, I was requested to register and directions for registration were provided. To access a particular survey type for any country, one must request and receive approval before using the data set. Consequently, I had to request to be granted access to the 2013 NDHS for Nigeria. The request was approved, and full access was granted to use the data set for the purpose of this research study (see Appendix). With this approval, I downloaded and saved the data set for review and subsequent analysis.

Operationalization of study variables. This research study explored the independent variables: antenatal care, and maternal sociocultural determinants; and the dependent variable: childhood immunization within two months of birth. The initial steps were to review the data set and extract data for only the States in the three geopolitical zones in northern Nigeria (North East, North West and North Central).

Antenatal care. Antenatal care is the care provided to presumed pregnant women during the period of her pregnancy to ensure she delivers safely. The variables to be studied for this independent variable included: the timing of 1st antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy.

Timing of 1st antenatal care visit from onset of pregnancy was defined as the initial time the woman visited someone for antenatal care during her pregnancy; described as *timing of 1st antenatal check (in months)* (USAID, 2013). This variable was measured at the ratio level; however, for this study, it was recoded at the nominal level as a dichotomous variable (< 3 and ≥ 3) with two categories.

Person who delivered antenatal care services was defined as the health professional or experienced person that provided the woman with care during her pregnancy, including information, on actions to take to ensure safe delivery. Measured as a categorical variable, it was coded as doctor, nurse/midwife, auxiliary midwife, community extension health worker, health professional, community/village health worker, traditional birth attendant and other person. However, for this study, it was recoded as health professional (doctor and nurse/midwife) and non-health professionals (auxiliary midwife, community extension health worker, community/village health worker, traditional birth attendant and other person).

Number of antenatal care visits was defined as the total number of antenatal care visits the woman attended during her pregnancy. Measured as a continuous variable, it

was coded as 0 for women who did not receive any antenatal care, (< 8 and ≥ 8), as WHO (2018c) recommended a minimum of eight antenatal care visits to reduce perinatal mortality and improved maternal experience to care for themselves and their babies.

Place of antenatal care delivery was defined as the location where the antenatal care was delivered to the woman during her pregnancy. This variable was measured as a categorical variable and coded as home, public and private.

Number of tetanus injection received was defined as the number of tetanus vaccinations received by the woman during the period of her pregnancy, measured as a continuous variable: 0 for no tetanus vaccinations, (< 2 and ≥ 2).

Maternal sociocultural determinants. Maternal sociocultural factors are those social, economic and cultural characteristics of mothers that influence their survival, ability to make decisions for themselves and their dependents, and general well-being. These determinants included highest educational level, literacy, religion, ethnicity, wealth index, age of respondent at first birth, current marital status, number of other wives, husband/partners educational level, and person who decides on health care.

Educational level is the level or status of education attained prior to the survey, and coded as 0= no education, 1= primary education, 2= secondary education, and 3= higher education.

Literacy is the woman's ability to read and coded as a dichotomous variable, 0= cannot read at all and 1 = can read.

Religion is the faith practiced by the woman, coded as 1=Christian, 2=Islam and 3=traditionalist.

Wealth index is the measure of the living standard of a household and it is measured as a categorical variable and coded as 1= poorest, 2 =poorer, 3= middle, 4= richer, and 5= richest. However, for this study it was recoded as 1=poor, 2= middle and 3=rich.

Age of respondent at 1st birth is the age of the woman when she delivered her 1st child, which is measured as a continuous variable, but was coded as a dichotomous variable of 1 =< 18 and 2= ≥ 18.

Current age of respondent is the last age of the woman before the survey was conducted, which was measured as a continuous variable.

Current marital status would be coded as 1= married or living with partner and 2= single (widowed, divorced, separated).

Number of other wives was defined as the number of co-wives married or living with husband/partner, indicating polygamy, and coded as 0= no other wives and 1= presence of co-wives.

Husband/partner educational level is the educational level of the woman's husband or partner prior to the survey, and coded as 0= no education, 1= primary education, 2= secondary education, and 3= higher education.

Person who decides on health care is the person who makes the decision on different aspects related to receipt of health care for the woman and children, such as the place to receive care, receipt of immunization, money to be spent and health professional to meet, measured as a categorical variable and coded as 1= respondent alone, 2= respondent and other person and 3= not respondent.

Dependent variable. The dependent variable for this study was childhood immunization within two months of birth. Children between the ages of $0 \leq 59$ months were selected for this study. The National Primary Health Care Development Agency (2017) stipulated the immunizations to be received within two months of birth to include Bacille Calmette-Guérin vaccine (BCG), 1st and 2nd doses of Oral Polio Virus (OPV_0, & OPV_1), Pentavalent vaccine (Diphtheria, Pertussis, Tetanus, Hepatitis B and Hemophilius Influenza type B), and 1st dose of Pneumococcal Conjugate Vaccine (PCV). However, the 2013 NDHS data set did not provide data on PCV and Hemophilius Influenza type B; also, the Pentavalent vaccine was split into DPT, Hemophilius Influenza type B and Hepatitis B during the time of the survey.

The dependent variable was coded as 0= received no immunization, 1= completed immunization with two months of birth (BCG, Pentavalent vaccine, OPV_0, & OPV_1), 2= incomplete, if any child received some of the required vaccinations. However, a child was also considered as having received complete immunization if the child received all vaccinations except OPV_0, to accommodate pre-term infants.

Data analysis plan. Data analysis for this study was conducted with SPSS v 25. The data analysis process began with a thorough review of the data set. The data set was reviewed and cleaned to remove missing data and address the issue of outliers because uncleaned data could produce incorrect analytical results and erroneous conclusions (Ilyas & Chu, 2015). However, although the 2013 NDHS data set had undergone thorough data editing as enumerated by NPS (2013), the purpose of my study was not the primary intention for the survey; hence the need for review of the individual

questionnaires for women. In addition, I also reviewed the DHS codebook to understand the data definitions.

To effectively manage the data for analysis, I categorized and recoded some variables as mentioned in the operationalization of study variables. Subsequently, I summarized the data by conducting descriptive analysis such as measures of frequency and measures of central tendency. The descriptive analysis generated tables, graphs and charts to provide a visual description of the data and also served as a guide for the appropriate inferential statistical techniques to be conducted.

Nayak and Hazra (2011) suggested that the appropriate statistical analytical techniques to be applied depend on the type of research questions of the study, the data type used in the analysis and the number of groups involved. To decide on the appropriate statistical test to use for continuous or quantitative data, I determined if the data set was normally distributed by observing the skewness and kurtosis. If the data were normally distributed, I would apply parametric tests. However, if the data were not normally distributed, I would use non-parametric tests. Furthermore, to examine the association between the predictor and outcome variables, I used multiple regression. The use of this analytical technique was beneficial for this study, as it allowed the determination of the effect of more than two predictor variables on the outcome variable (Frankfort-Nachmias, & Leon-Guerrero, 2015).

Summarily, after data cleaning and addressing the missing data, the data analysis procedure consisted of descriptive and inferential statistics (Frankfort-Nachmias, & Leon-Guerrero, 2015). The data analysis procedure began with description of the

variables of interest, using different techniques such as measures of central tendency, measures of frequencies, and measures of dispersion. Descriptive analysis was the foundation stage of the data analysis process that summarized the sample, and subsequently, if needed, produces information for advanced analysis. Inferential analysis is the successive stage that allows one to draw conclusions from the samples in order to make generalizations of the findings to the entire population, such as Chi Square, Logistic regression, and Analysis of Variance (Frankfort-Nachmias, & Leon-Guerrero, 2015).

Research questions and hypotheses. The research question helps define the scope of the study and influence the appropriate research design (Burkholder, Cox, & Crawford, 2016).

Research Question 1: Is there an association between antenatal care (*the timing of 1st antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy*) and uptake of scheduled routine immunization among infants from birth to two months of life in northern Nigeria?

$H1_0$: There is no statistically significant association between antenatal care and the uptake of scheduled routine immunization among infants from birth to two months of life in northern Nigeria after controlling for respondent's checkup after delivery and baby postnatal checkup within two months of birth.

$H1_1$: There is a statistically significant association between antenatal care and the uptake of scheduled routine immunization among infants from birth to two months of life

in northern Nigeria after controlling for respondent's checkup after delivery and baby postnatal checkup within two months of birth.

Research Question 2: Is there an association between maternal sociocultural influences (*highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital status, number of other wives, husband/partners educational level, and person who decides on health care*) and the uptake of scheduled routine immunization among infants from birth to two months of life in northern Nigeria?

$H2_0$: There is no statistically significant association between maternal social cultural influences and the uptake of scheduled routine immunization among infants from birth to two months of life in northern Nigeria after controlling for age of respondent at start of 1st marriage and respondents' rank among other wives

$H2_1$: There is a statistically significant association between maternal social cultural influences and the uptake of scheduled routine immunization among infants from birth to two months of life in northern Nigeria after controlling for age of respondent at start of 1st marriage and respondents' rank among other wives.

Threats to Validity

Validity is the absence of any inaccuracies in a study; the degree to which the measures employed in a study correctly specifies the outlined procedures (Frankfort-Nachmias, & Leon-Guerrero, 2015). Cross-sectional studies are commonly threatened by internal and external validity (Carlson & Morrison, 2009). While internal validity focuses on the strength of the associations between the predictor and outcome, external validity

refers to the extent to which the study findings can be generalized to the population from whence the sample was drawn.

Internal Validity

Barbie (2017) explained that threats to internal validity occur when there are other factors, except the stipulated independent variables, that influence the outcome. In other words, threats to internal validity are those influences that could prevent accurate and precise inferences to be drawn about the data set, and thus may result in erroneous conclusions of this study (Creswell, 2009). For this study, the major threat to internal validity could be recall bias. Recall bias is one of the major threats to internal validity that often occurs in self-reported studies (Hassan, 2006). This type of information bias happens when the information provided by the respondents are inaccurate because of failure to recall the occurrence of the event. However, Frankfort-Nachmias, and Leon-Guerrero (2015) proposed that large sample sizes oftentimes addresses the issue of internal validity. In addition, to tackle this threat to internal validity, measures taken included translation of the questionnaire to local language that would convey the true meaning of the questions and pre-test of survey instruments to ensure accuracy of content (NPC, 2013). Another possible threat to internal validity could be missing data and possible errors during the data collection process. This study focused on northern Nigeria; hence security threat in these parts of the country could have affected coverage during the period the survey was conducted, possibly posing a threat to internal validity.

External Validity

External validity queries the capacity and degree to which the study findings can be generalized to the entire population from where the sample was drawn. This issue arises when inaccurate inferences are drawn and incorrect conclusions made about the sample data and then generalized to the population, similar locations, and/or past or future conditions (Creswell, 2009). Polit and Beck (2010) explained that generalization is typical for quantitative studies. Thus, a threat to external validity queries the fundamentals of any quantitative study. Carlson and Morrison (2009) explained that one of the warning signs of a study that is threatened by external validity is the use of a non-representative sample. However, the multi-stage stratified sampling technique employed by the 2013 NDHS ensured that nationally representative samples were drawn from the entire population. This measure also reduces the threat to external validity.

For this study, the possible threats to external validity included accuracy and objectivity of the chosen study design, as the research design considered the characteristics of the population sample only at that point in time and may not be accurate at any other period. In other words, the findings of the research may not be generalized assertively and without doubt beyond the period that the study was conducted. However, the predicted use of a large sample size in this study may reduce this threat to external validity. Another possible threat to external validity is the 'real world' versus the 'experimental world'. Sometimes, respondents provide untrue information because they feel it may be profitable. Such fallacious information may affect the study findings; hence generalizing to the entire population could produce inaccuracies.

Ethical Procedures

This research study involved the use of secondary data; hence, there were minimal ethical considerations because of indirect contact with the human research subjects. However, the primary researchers obtained Institutional Review Board (IRB) approvals. National population Commission (2013) reported that local ethical approval was obtained from the National Health Research Ethics Committee (NHREC). For this study, I sought permission for ethical approval from Walden University IRB, with IRB approval number 03-21-19-0634205, before proceeding with data retrieval, analysis of the secondary data set and subsequent development of the report. Furthermore, formal authorization from the relevant bodies holding the data set enabled me to download and use the data set from the 2013 NDHS and produce a report of my study findings. Upon retrieval of the data set after authorization, the data set was securely stored in an external drive that was protected with a password, to prevent its' use without authorization from the relevant data owners. The external drive and hard copies of the data was kept in a safe that was designated for storage.

With this approval, I had the legal authorization to publish the study findings and also my study could also serve as a guide and background for future studies. Upon request, the study findings would be shared with USAID. After data analysis and development of the report, the data set would be retained for at least 5 years as stipulated by the IRB.

Summary

This study adopted a cross-sectional design to provide a secondary analysis of the 2013 NDHS data set. The study participants involved women aged 15-49 years in all the northern States of Nigeria to examine components of antenatal care and sociocultural factors that may influence uptake of childhood immunization within two months of birth.

Section 2 of this study focused on the research design, the rationale and a description of the study methodology. It also provided a detailed explanation of the data management process, describing the data collection process, the sampling procedures, criteria for inclusion and exclusion of participants, appropriate sample size that was used, including the rational for calculating the effect size, alpha level and power level. In addition, this section contained information on access to the secondary data set that was used, survey instruments and operationalization of constructs and study variables. Finally, the data analysis plan was also described in detail and information on possible threats to validity and ethical concerns were provided.

The results that were generated from the already explained statistical analysis and findings of this study were presented in Section 3.

Section 3: Presentation of the Results and Findings

Introduction

I conducted this quantitative study to determine if components of antenatal care and maternal sociocultural determinants influence uptake of childhood immunization within 2 months of birth among women of reproductive age in northern Nigeria. Study findings may provide insight on the possible predictors for uptake of childhood immunization and the probable causes of poor childhood immunization coverage in this region. The key research questions I sought to answer were, as follows:

Research Question 1: Is there an association between antenatal care (the timing of first antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy) and uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria?

Research Question 2: Is there an association between maternal sociocultural influences (highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital/union status, number of other wives, husband/partners educational level, and person who decides on health care) and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria?

The null hypotheses stipulated that there is no association between antenatal care and uptake of scheduled routine immunization among infants from birth to 2 months of

life, nor between maternal sociocultural influences and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria.

In this section, I reviewed the data collection process and provide a description of the statistical analyses that I used to answer the research questions and test the hypotheses. The first part of this section includes a description of the statistical analyses that were used to examine antenatal care, sociocultural, and child immunization characteristics of the study population. In the subsection that follows, I discuss the inferential statistical techniques that were used to test the hypotheses for the research questions and determine the strength of the association between the predictors and outcome variables. The descriptive sociodemographic, antenatal care, and child immunization characteristics are presented in tables and figures, while the inferential statistical results are presented in tables.

Data Collection

The primary study involved the use of field workers, with a minimum of Ordinary National Diploma education, who were adequately trained and supervised by technical team members and state coordinators to conduct the data collection (NPC & ICF International, 2014). According to NPC & ICF International (2014), all aspects of the data collection process were pretested, and the survey instruments (questionnaires) were thoroughly reviewed prior to data collection. The entire process for the survey was between 18 and 20 months; data collection occurred from February 2013 to June 2013 for the 45 households in each Enumeration Area (NPC & ICF International, 2014).

This study was a secondary data analysis of an existing data set; hence, recruitment of the participants for data collection was not required. The process of data collection was according to plan as indicated in Section 2 and commenced with a request for use of the data set. The host organization granted my request and provided me with official approval and permission to use the data set (see Appendix). Subsequently, I also obtained IRB approval from Walden. After obtaining these approvals, I downloaded the data set from the host website and reviewed cases in using my criteria for inclusion and exclusion. Subsequently, a total sample size of 17,016 was generated. I consider the study sample to be an unbiased and objective representation of the larger study population because of the sampling method employed by the primary study authors (NPC & ICF International, 2014).

Results

Descriptive Characteristics of the Sample Population

In this part of the section, I provide a detailed description of antenatal care, sociocultural, and child immunization characteristics of the study population.

Regional distribution of participants. The distribution of the participants in the three geopolitical zones (North Central, North East, and North West) is described in Table 1 using frequencies, percentages, and cumulative percentages. The region with the most (45.4%) participants who met the inclusion criteria were permanent residents or visitors in North West at the time the survey was conducted.

Table 1

Description of Participants in the Three Geopolitical Zones

Zone	Frequency	Percentage	Cumulative percentage
North Central	4,190	24.6	24.6
North East	5,096	29.9	54.6
North West	7,730	45.4	100.0
Unweighted total (*n*)	17,016	100.0	

Univariate Analyses

Antenatal care characteristics. I studied the following antenatal care characteristics: the timing of first antenatal care visit from onset of pregnancy, person who delivered the care, number of antenatal visits during the pregnancy, place where antenatal care was delivered, and number of tetanus injections received during pregnancy. The unweighted sample size was 17,016.

Table 2 provides the description of the antenatal care characteristics for the sample population in frequencies, percentages, and cumulative percentages. Most (73.4%) of the women presented with pregnancies for the first time at more than 3 months of gestation. Of the proportion of women who had access to health care, 46.3% received antenatal care from a health professional comprising a doctor, midwife, or nurse, while only 7.6% of the participants received antenatal care from nonhealth professionals such as auxiliary midwives and traditional birth attendants. Similarly, of the proportion of women who visited antenatal care clinics, almost half (45.2%) attended these clinics less than eight times. Most (89.1%) of the participants attended their antenatal care clinics in

public health facilities, while only 0.8% of the women received theirs at home. Just half (50.7%) of the participants did not receive any shot of tetanus injection during pregnancy.

Table 2

Antenatal Care Characteristics of the Sample

Characteristic	Frequency	Percentage	Cumulative percent
Timing of First Antenatal Care Visit			
≤ 3 months	1,993	26.6	26.6
> 3 months	5,513	73.4	100.0
Unweighted Total (*n*)	17,016	100.0	
Person Who Delivered the Care			
Health professional	6,312	46.3	46.3
Non-health professional	1,039	7.6	53.9
No access to care	6,277	46.1	100.0
Unweighted Total *(n*)	17,016	100.0	
Number of Antenatal Visits During Pregnancy			
< 8 visits	5,917	45.2	45.2
≥ 8 visits	1,470	11.2	56.4
No visit	5,700	43.6	100.0
Unweighted Total (*n*)	17,016	100.0	
Place Where Antenatal Care was Delivered			
Home	62	0.8	0.8
Private	741	10.0	10.9
Public	6,581	89.1	100.0
Unweighted total (*n*)	17,016	100.0	
Number of Tetanus Injections Received During Pregnancy			
≥ 1 shot	6,524	49.3	49.3
No shots	6,712	50.7	100.0
Unweighted total (*n*)	17,016	100.0	

Sociocultural characteristics. The socio-cultural characteristics that were studied were highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital/union status, number of other wives,

husband/partners educational level and person who decides on health care. The sample size was weighted to increase the representation and generalizability to the target population (Miratrix, Sekhon, Theodoridis, & Campos, 2018; Solon, Haider, & Wooldridge, 2015); the weighted sample size was 17,576. The mean age of the respondents was 31.27±8.74 (table 3).

Table 3

Description of Participants by Current Age

Statistic	
Mean	31.27
Median	30.00
Std. Dev.	8.74
Minimum	15
Maximum	49
Weighted Sum (n)	17,576

Unweighted sample size (n) = 17,016

Table 4 provides a description of the key socio-cultural characteristics of the sampled population in frequencies, percentages and cumulative percentages. Majority (64.3%) of the participants had no educational background, while only 4.5% had higher education. A higher proportion (72.8%) of the sample population cannot read, while 27.2% of the women could read. Predominate (77.6%) proportion of the sample population practice Islam, while only a few (1.1%) were traditionalists. More (59.1%) than half of the population was rated poor for the wealth index indicator, while 19.1% were in the middle class. The category with the highest (46.4%) proportion of participants delivered their first child between the ages of 16 to 19 years. The age groups

for the participants were almost evenly distributed; however, the highest (39.3%) proportion of the participants for the study was between the ages of 25 to 34 years. Majority (94.6%) of the participants were either married or living in union with a partner, while only 5.4% were either single or not in union with their partner. More (58.5%) of the women did not share their husbands/partners with other wives, while 41.5% of the women were the only wives of their husbands/partners. Majority (53.1%) of the husband/partners had no educational background, while 12.7% of them had higher educational qualifications. For most (72.9%) of the participants, their husbands/ partners decide on health care, while only 2.9% of the women alone decide on their health care.

Table 4

Key Socio-cultural Characteristics of the Sample

	Frequency	Percentage	Cumulative Percent
Highest Educational Level			
No education	10946	64.3	64.3
Primary	2844	16.7	81.0
Secondary	2465	14.5	95.5
Higher	761	4.5	100.0
Unweighted Total (n)	17016	100.0	
Literacy			
Cannot read	12262	72.8	72.8
Can read	4574	27.2	100.0
Unweighted Total (n)	17016	100.0	
Religion			
Christian	3601	21.3	21.3
Islam	13144	77.6	98.9
Traditionalists	183	1.1	100.0
Unweighted Total (n)	17016	100.0	
Wealth Index			
Poor	10054	59.1	59.1
Middle	3246	19.1	78.2
Rich	3716	21.8	100.0
Unweighted Total (n)	17016	100.0	

	Frequency	Percentage	Cumulative Percent
Age Groups at First Birth			
12-15	3847	22.6	22.6
16-19	7888	46.4	69.0
20-24	4003	23.5	92.5
25-45	1278	7.5	99.8
Unweighted Total (n)	17016	100.0	
Current Age Groups			
15-24	3876	22.8	22.8
25-34	6680	39.3	62.0
35-49	6460	38.0	100.0
Unweighted Total (n)	17016	100.0	
Current Marital/Union status			
Married/In union	16103	94.6	94.6
Single/Not in union	913	5.4	100.0
Unweighted Total (n)	17016	100.0	
Number of other wives			
No other wives	9779	58.5	58.8
Presence of other wives	6863	41.5	100.00
Unweighted Total (n)	17016	100.0	
Husband/Partner's Educational Level			
No education	8855	53.1	53.1
Primary	2512	15.1	68.2
Secondary	3193	19.1	87.3
Higher	2117	12.7	100.0
Unweighted Total (n)	17016	100.0	
Person Who Decides on Health Care			
Husband/partner alone	11696	72.9	72.9
Woman alone	467	2.9	75.8
Woman and husband/partner together	3880	24.2	100.0
Unweighted Total (n)	17016	100.0	

Childhood immunization. Table 5 shows that majority (72.3%) of the children were not immunized, while 27.7% of the children were completely or incompletely immunized within two months of birth.

Table 5

Description of children immunized within two months

	Frequency	Percentage	Cumulative percentage
Immunized	1527	27.7	27.7
Non-immunized	3987	72.3	100.0
Weighted Total (n)	17,576	100.0	

Unweighted total = 17,016

Childhood immunization characteristics for uptake of OPV_0 and OPV_1 within two months of birth are displayed in figures 4 and 5 respectively. The exceeded category in the figures represents those children that still received the required immunization but after the stipulated time of two months from birth. In figure 4, majority (84.87%) of the children did not receive the 1st dose of OPV, while 1.8% of the children only received their 1st dose of OPV after two months of birth. Similarly, majority (75.8%) of the children did not receive their 2nd dose of OPV, while 6.5% of the children only received their 2nd dose of OPV after two months of birth as indicated in figure 5.

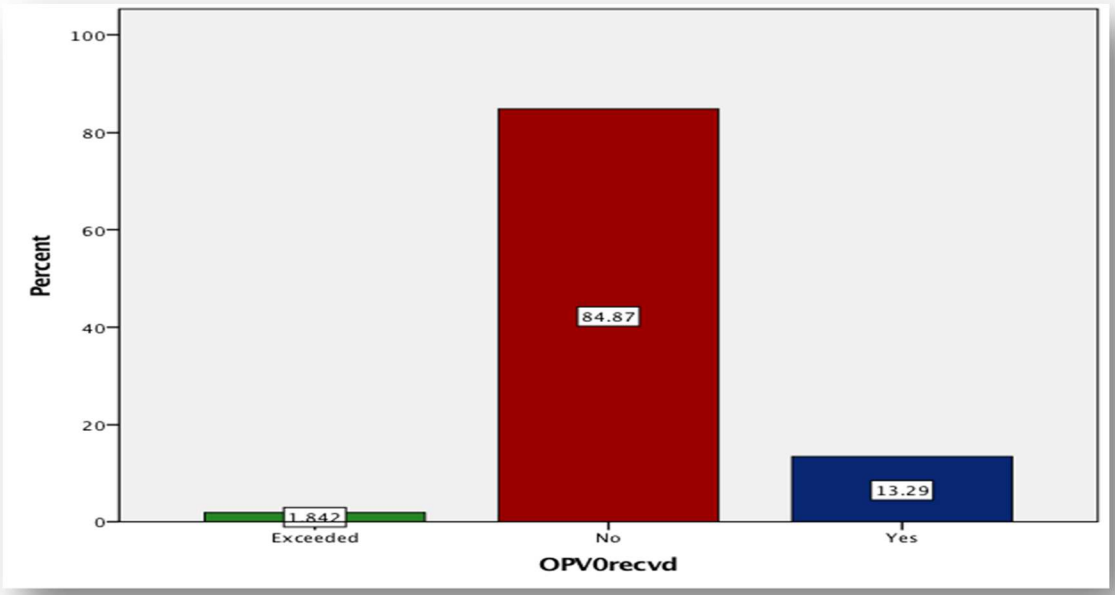

Figure 4: Weighted distribution of OPV_0 received within two months of birth.

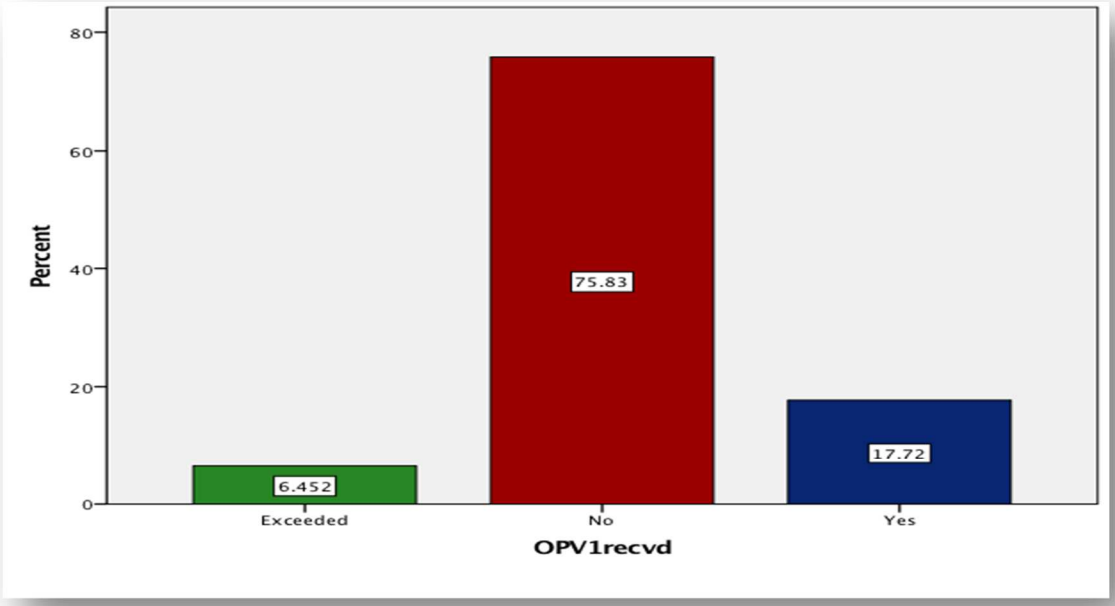

Figure 5: Weighted distribution of OPV_1 received within two months of birth.

Figures 6 and 7 show the distribution of children who received 1st and 2nd doses of DPT within two months of birth respectively. Most (84.55%) of the children did not receive the 1st dose of DPT, while only 3.93% received the 1st dose of DPT after two months of birth (figure 6). Similarly, in figure 7, a low (4.59%) proportion of the children received the 2nd dose of DPT within the stipulated time of two months from birth, while the highest (88.31%) proportion of children did not receive the 2nd dose of DPT.

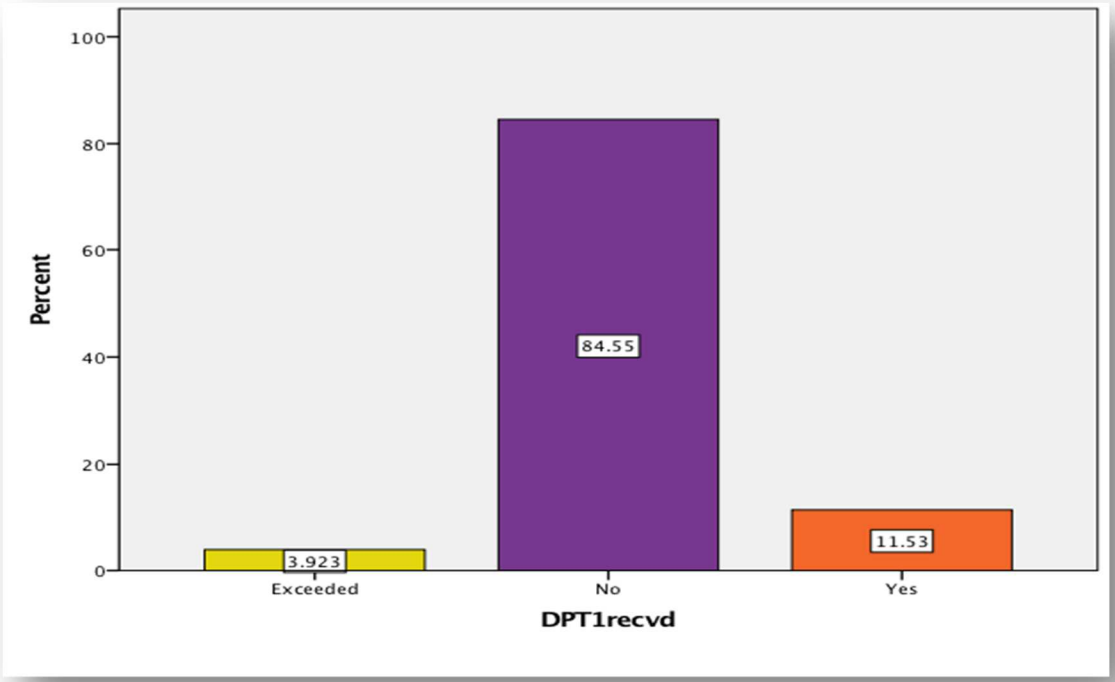

Figure 6: Weighted distribution of DPT_1 received within two months of birth.

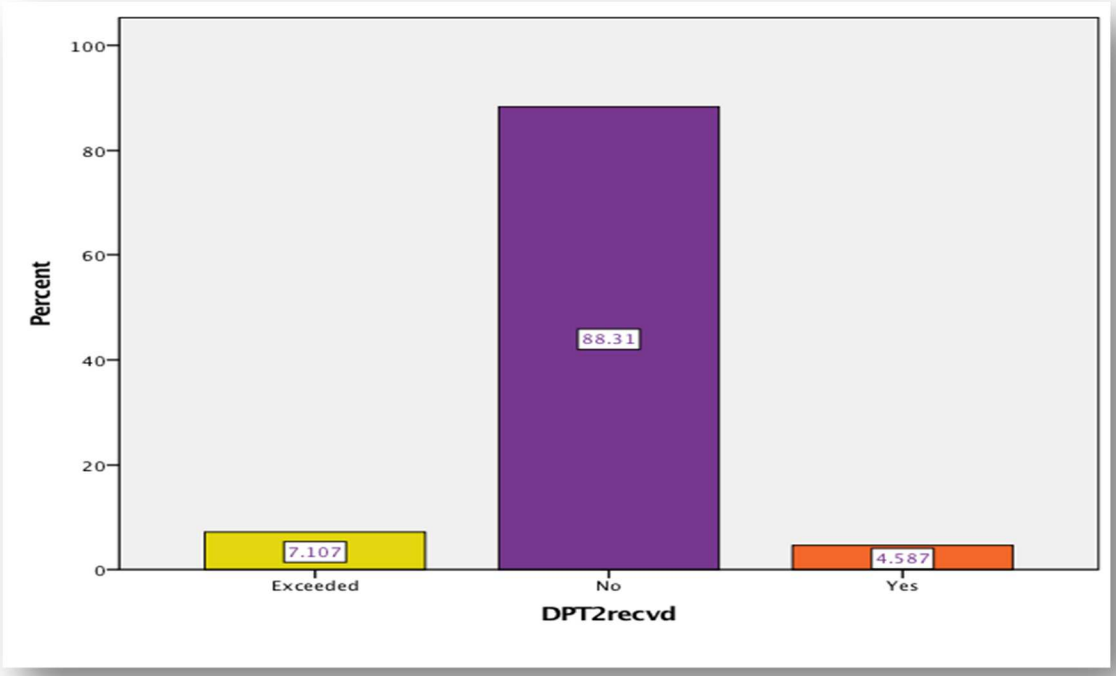

Figure 7: Weighted distribution of DPT_2 received within two months of birth.

Figure 8 is a weighted distribution of children who received BCG vaccine within two months of birth. Majority (82.83%) of the children did not receive BCG immunization. While 14.58% of the children received BCG immunization within the scheduled time of two months, 2.58% of the children still received the BCG immunization but after two months of birth.

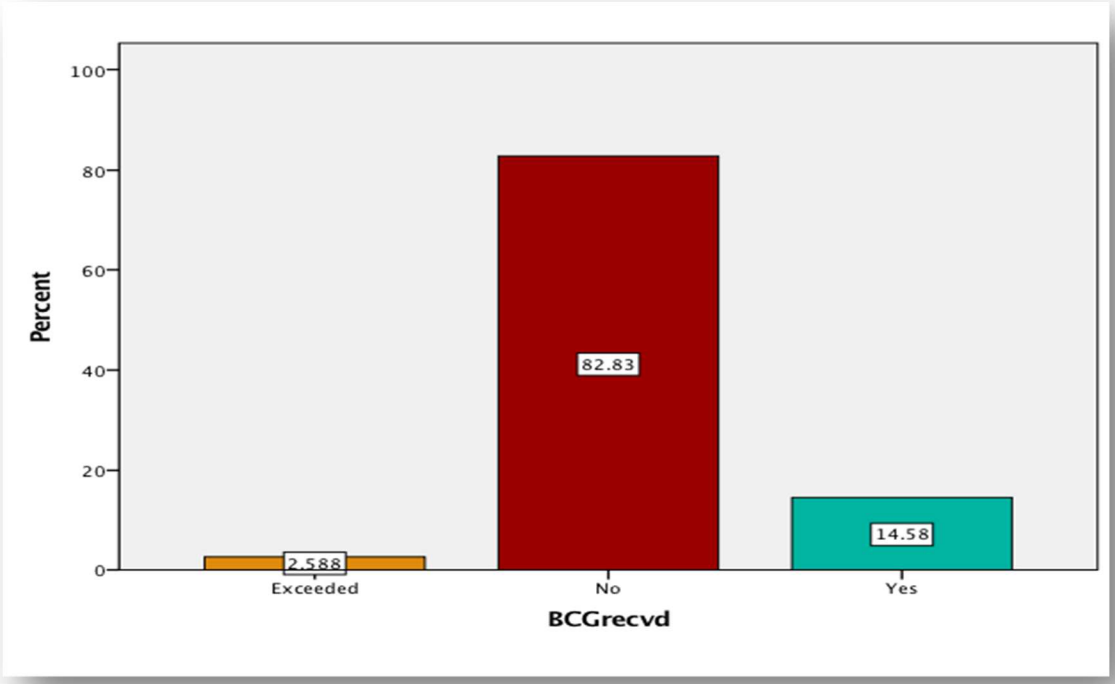

Figure 8: Weighted distribution of BCG received within two months of birth.

The pooled childhood immunization characteristics for all the vaccines within two months of birth (OPV_0 and OPV_1; DPT_0 and DPT_1; BCG) are displayed in figures 9 and 10. Three level weighted distribution of the pooled immunization that was presented in figure 9 showed that only 7.1% of the children were completely immunized within two months of birth, while 20.53% of the children did not completely receive the scheduled immunization within two months of birth. Most (72.31%) of the children whose mothers were included in this study, did not receive their scheduled immunization. In figure 10, the two-level weighted distribution of the pooled immunization characteristics indicated

that only 27.69% of the children were immunized within two months of birth, while 72.31% of these children did not receive any immunization.

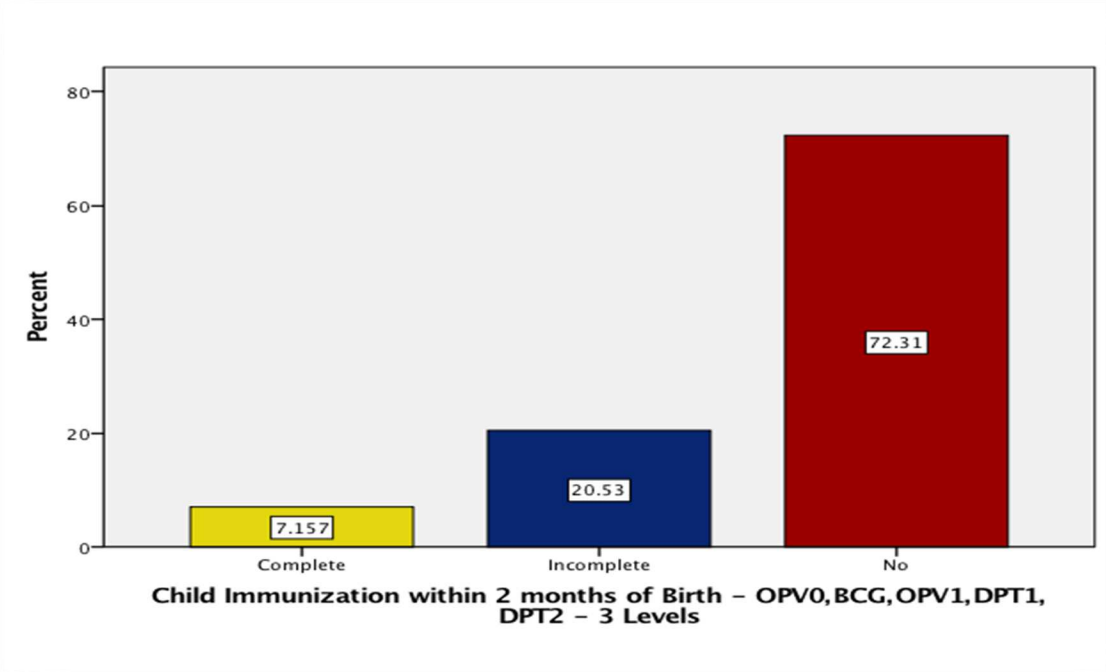

Figure 9: Weighted distribution of child immunization received within two months of birth at three levels.

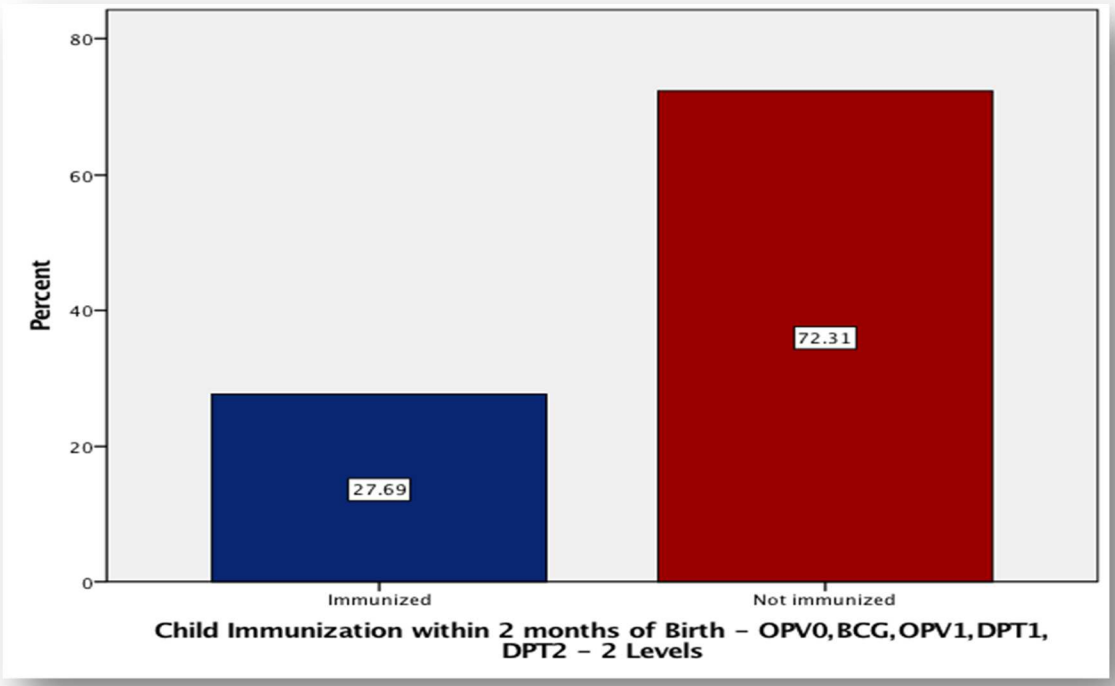

Figure 10: Weighted distribution of child immunization received within two months of birth at two levels.

Bivariate Analyses

Research Question 1. The 1st research question focuses on assessing the association between antenatal care and uptake of scheduled routine immunization among infants within two months of birth in northern Nigeria. The variables studied (*Timing of 1st antenatal care visit, person that delivered the care, number of antenatal care visits during pregnancy, and number of tetanus injection received during pregnancy)* were statistically significant (p<0.05) predictors of uptake of immunization within two months of birth (Table 6). However, the

potential confounding variables (*respondent's checkup after delivery and baby postnatal checkup within two months of birth*) were not statistically significant predictors of immunization within two months of birth.

Table 6

Influence of antenatal care on uptake of immunization within two months of birth - two levels

Parameter Estimates	Immunized (%)	95% Confidence Interval		Std. Error	Chi-square (χ^2)	*P value*
		Lower	Upper			
Timing of 1st Antenatal Care Visit					43.93	0.000
≤ 3 months	61.3	55.6	66.7	2.8		
> 3 months	46.8	43.3	50.3	1.8		
Person Who Delivered the Care						
No access to care	3.8	2.9	5.0	0.5		
Health professional	51.9	48.2	55.6	1.9	1451.82	0.000
Non-health professional	35.6	29.3	42.4	3.4		
Number Of Antenatal Visits During Pregnancy						
< 8 visits	45.5	42.0	49.0	1.8	1500.68	0.000
≥ 8 visits	69.7	64.5	74.4	2.5		
No visit	4.0	3.1	5.2	0.5		
Place Where Antenatal Care was Delivered						
Home	41.3	24.4	60.5	9.6	18.85	0.001
Private	62.8	55.0	69.9	3.8		
Public	48.6	45.1	52.2	1.8		
Number of Tetanus Injections Received During Pregnancy					1326.89	0.000
≥ 1 shot	52.4	48.9	55.8	1.8		
No shots	7.7	6.3	9.4	0.8		

Research Question 2. With this second research question, I attempted to answer the question 'Is there an association between maternal sociocultural influences and the uptake of scheduled routine immunization within two months of life in northern Nigeria?' Table 7 indicated the variables studied (*highest educational level, literacy, religion, wealth index, age of respondent at first birth, current marital status, number of other wives, husband/partners educational level and person that decides on health care*) were statistically significant ($p<0.05$) predictors of uptake of immunization within two months of birth. However, *current age of respondent, age of respondent at start of 1st marriage and respondents' rank among other wives* was not statistically significant predictors of immunization within two months of birth.

Table 7

Influence of sociocultural determinants on uptake of immunization within two months of birth – two levels

Parameter Estimates	Immunized (%)	95% Confidence Interval		Std. Error	Chi-square (χ^2)	*P value*
		Lower	Upper			
Highest Educational Level						
No education	13.6	11.4	16.1	1.2	1271.67	0.000
Primary	41.2	36.4	46.2	2.5		
Secondary	65.7	60.7	70.4	2.5		
Higher	78.9	70.1	85.6	4.0		
Literacy						
Cannot read	16.2	14.0	18.8	1.2	1053.50	0.000
Can read	62.1	57.7	66.3	2.2		
Religion						
Christian	60.4	52.3	67.9	4.0	563.58	0.000
Islam	21.5	18.9	24.3	1.4		
Traditionalists	7.2	2.7	18.1	3.6		

Parameter Estimates	Immunized (%)	95% Confidence Interval		Std. Error	Chi-square (χ^2)	*P value*
		Lower	Upper			
Wealth Index						
Poor	13.5	11.2	16.2	1.3		
Middle	34.5	28.8	40.6	3.0	1001.02	0.000
Rich	60.9	55.3	66.1	2.8		
Age Groups at First Birth						
12-15	18.9	15.7	22.6	1.8		
16-19	24.3	21.4	27.5	1.6	168.0	0.000
20-24	36.5	32.2	41.0	2.2		
25-45	44.6	38.1	51.3	3.4		
Marital/ Current Union status						
Married/ In union	27.2	24.4	30.1	1.5	26.64	0.000
Unmarried/Single	46.9	37.0	57.0	5.1		
Number of other wives					49.74	0.000
Presence of other wives	21.6	18.4	25.2	1.7		
No other wives	30.6	27.4	34.0	1.7		
Husband/Partner's Educational Level						
No education	10.0	8.2	12.1	1.0		
Primary	33.4	28.4	38.7	2.6		
Secondary	49.1	43.9	54.3	2.7	1251.17	0.000
Higher	71.5	66.3	76.1	2.5		
Person Who Decides on Health Care						
Husband/partner alone	22.2	19.6	25.0	1.4		
Woman alone	46.1	33.9	58.7	6.4	227.62	0.000
Woman and husband/partner together	44.0	38.4	49.8	2.9		

Multivariate analysis

Research Question 1. Table 8 is a display of the main predictors of antenatal care, which were statistically significant from the bivariate analysis, with their interactive effect. The predictors were considered together in the model and indicated statistical significance $\chi^2 = 213.7$, $p<0.001$. The model showed that the person who delivers antenatal care, number of antenatal visits during pregnancy, and number of tetanus injections received during pregnancy are statistically significant predictors of uptake of immunization within two months of birth at $\chi^2 (1) = 8.59$, $p< 0.01$; $\chi^2 (1) = 13.97$, $p< 0.001$; $\chi^2 (1) = 19.08$, $p< 0.001$respectively, while the timing of 1st antenatal care visit and place where antenatal care was delivered were not statistical significant predictors of uptake of immunization within two months of birth. Similarly, the respective highest values of these predictors against their reference variables for odds ratio were OR = 1.636, CI (1.176, 2.276); OR = 1.598, CI (1.249, 2.044); OR = 1.814, CI (1.387, 2.372).

Table 8

Model of Antenatal care (timing of 1st antenatal care, person who delivered the care, number of antenatal visits, place of antenatal care and number of tetanus injection) on uptake of immunization within two months of birth

Parameter Estimates	B	Std. Error	Wald.	Odds ratio	95% Confidence Interval for Odds Ratio	
					Lower	Upper
Timing of 1st Antenatal Care Visit			2.90			
≤ 3 months	0.231	0.136		1.260	0.965	1.645
Person Who Delivered the Care			8.59*			
Health professional	0.492	0.168		1.636	1.176	2.276
Number Of Antenatal Visits During Pregnancy			13.97**			
≥8 visits	-0.469	0.125		1.598	1.249	2.044
Place Where Antenatal Care was Delivered			0.611			
Home	0.085	0.424		1.088	0.473	2.504
Private	0.179	0.230		1.196	0.762	1.879
Number of Tetanus Injections Received During Pregnancy			19.08**	1.814		
≥ 1 shot	0.596	0.136			1.387	2.372

*n =2822; * = p< 0.01; ** = = p< 0.001; Model Chi Sq = 213.7; Cox & Snell R-Sq = 0.154; Nagelkerke R-Sq = 0.205*
Dependent variable: Child Immunized within 2 months (reference category = No)
Reference categories: > 3 months, non-health professionals, <8 visits, public, and no shots.

Further analysis to determine the predictive strength of the components of antenatal care revealed that the person that delivered antenatal care, number of antenatal care visits and number of tetanus injections during pregnancy were statistically

significant predictors of uptake of immunization within two months of birth. The model showed that a woman who received antenatal care from a health professional (doctor and nurse/midwife) has 1.64 greater odds of immunizing her child within two months of birth than a woman who received antenatal care from a non-health professional (auxiliary midwife, community extension health worker, community/village health worker, and traditional birth attendant). Similarly, women who made contacts and attended antenatal care at least eight times were 1.6 times more likely to immunize their children within two months of birth than women who had less than eight antenatal care visits. In addition, the model revealed that receipt of tetanus injection during pregnancy is a predictor of uptake of childhood immunization within two months of birth; with women who received at least one shot of tetanus injection having 1.38 greater odds of immunizing their children than those who did not receive any shots of tetanus injection during pregnancy.

Research Question 2. The model of social-cultural determinants was displayed in Table 9. The statistically significant predictors with their interactive effect were considered at once and revealed statistical significance $\chi^2 = 479.35$, $p<0.001$. The model indicated that the highest educational level of participant, religion, wealth index, husband/partner's educational level and person who decides on health care were statistically significant predictors of uptake of immunization within two months of birth at $\chi^2\,(3) = 11.67$, $p< 0.01$; $\chi^2\,(2) = 18.52$, $p< 0.001$; $\chi^2\,(2) = 58.90$, $p< 0.001$; $\chi^2\,(2) = 77.18$, $p< 0.001$ and $\chi^2\,(2) = 18.08$, $p< 0.001$ respectively, while literacy, age at first birth and number of other wives were not statistical significant predictors of uptake of immunization within two months of birth. Likewise, considering the respective highest

values of these predictors against their reference variables for odds ratio showed OR = 2.059, CI (1.282, 3.307); OR = 5.843, CI (1.857, 18.387); OR = 3.498, CI (2.488, 4.919

Table 9

Model of socio-cultural determinants (highest educational level of respondent, literacy, religion, wealth index, age groups at first birth, number of other wives, husband/partner's educational level and person who decides on health care) on uptake of immunization within two months of birth

Parameter Estimates	Std. Error	Wald.	Odds Ratio	95% Confidence Interval for Odds Ratio	
				Lower	Upper
Highest Educational Level		11.67*			
Primary	0.338		1.560	1.159	2.098
Secondary	0.287		2.059	1.282	3.307
Higher	0.244		1.968	1.012	3.827
Literacy		0.88			
Can read	0.210		1.218	0.806	1.841
Religion		18.52**			
Christian	0.583		5.843	1.857	18.387
Islam	0.575		2.922	0.944	9.047
Wealth Index		58.90**			
Middle	0.173		1.836	1.370	2.460
Rich	0.152		3.498	2.488	4.919
Age Groups at First Birth		2.78			
16-19	0.202		0.971	0.773	1.221
20-24	0.179		1.149	0.874	1.512
25-45	0.184		1.110	0.746	1.651
Number of other wives		1.09			
No other wives	0.109		0.892	0.720	1.106
Husband/Partner's Educational Level		77.18**			
Primary	0.195		2.597	1.889	3.569
Secondary	0.185		2.611	1.939	3.516
Higher	0.154		4.546	3.099	6.668

Person Who Decides on Health Care			18.08**			
Husband/partner alone	-0.037	0.264		0.964	0.574	1.620
Woman and husband/partner together	0.565	0.283		1.759	1.008	3.071

*n =5067; * = p< 0.01; ** = = p< 0.001; Model Chi Sq = 479.35; Cox & Snell R-Sq = 0.273; Nagelkerke R-Sq = 0.395*
Dependent variable: Child Immunized within 2 months (reference category = No)
Reference categories: No education, cannot read, traditionalists, poor, 12-15 age group, presence of other wives, no education and woman alone.

The model of the strength of association shown in table 9 indicated that the participants highest level of education, religion, and wealth index, as well as the husband/partner's educational level and person who decide on health care were statistically significant predictors for the uptake of immunization within two months of birth. The results revealed that women with no education had the highest risk of not immunizing their children within two months of birth. All the educational levels (primary, secondary and higher) were found to be statistically significant predictors. However, amongst all the educational levels, women who attained secondary education had the highest likelihood of 2.1 times greater for immunizing their children when compared with no education. Similarly, women who practiced traditional religion and were poor also had the highest risk of not immunizing their children within two months of birth. Christian women had 5.8 times greater odds of immunizing their children as compared to children of women that practiced traditional religion. Furthermore, children born to women who practiced Islam had the same odds as those born to women who practiced traditional religion. Hence, women who practiced Islam and traditional religion had a higher risk of not immunizing their children compared with

Christian women. Women in the categories of middle and rich classes had 1.8- and 3.5-times greater likelihood of immunizing their children respectively than poor women.

Husband/partner's educational level was shown to be a statistically significant predictor of uptake of immunization within two months of birth; with women whose husband/ partner had no education possessing the highest risk of not immunizing their children, while women whose husband/ partner attained higher education were 4.5 times more likely to immunize their children than those with no education. In addition, women who made the decision on health care jointly with their husband/ partner were found to have 1.8 times greater likelihood of immunizing their children when compared to women who decided on health care alone.

The findings of this study revealed that the null hypotheses which postulated that there is no association between antenatal care and uptake of scheduled routine immunization among infants from birth to two months of life, nor between maternal sociocultural influences and the uptake of scheduled routine immunization among infants from birth to two months of life in northern Nigeria would be rejected. This result strengthens the assumption that antenatal care components such as number of visits, person who delivers antenatal and number of antenatal care visits received during pregnancy influence uptake of immunization within two months of birth. In addition, the assertion that certain maternal socio-cultural factors such as religion and wealth index also influence uptake of immunization within two months of birth holds true.

Summary

The result of the secondary data analysis of the 2013 NDHS was presented in this section. An unweighted sample size of 17,016 participants from the three northern geopolitical zones (North Central, Northeast and Northwest) was used in the study. Univariate, bivariate and multivariate analyses were conducted to answer the research questions by determining the influence of antenatal care and maternal sociocultural factors on uptake of childhood immunization within two months of birth. There were statistically significant predictors of childhood immunization within two months of birth; hence underscoring the importance of these predictors in relation to immunization uptake. The findings of this study produced interesting results that could be applied to practical actions and further studies in the field.

The final section of this study would provide an in-depth discussion and interpretation of the findings, with comparisons to literature from similar studies. In addition, the limitations and implications for social change would also be discussed in the following section.

Section 4: Application to Professional Practice and Implications for Social Change

Introduction

Regional disparity as demonstrated by the immunization coverage rates between northern and southern Nigeria prompted the need for this study. Hence, the purpose of this study was to assess features of antenatal care and maternal sociocultural determinants that could influence uptake of childhood immunization within 2 months of birth in northern Nigeria. I designed this correlational cross-sectional study to provide evidence of the possible factors that may influence uptake of childhood immunization within 2 months of birth in northern Nigeria and consequently affect immunization coverage in this region. I conducted a secondary data analysis of an existing data set from the 2013 NDHS, which involved face-to-face administration of questionnaires to elicit data from the participants. I conducted univariate, bivariate, and multivariate analyses of the NDHS data set using SPSS Version 21.

The initial part of this section involves a concise summary of the findings, followed by in-depth interpretation of the findings and answers to the research questions. Subsequently, the study limitations, recommendations from the study, and implications for professional practice and positive social change are elucidated. The section ends with a conclusion to the study.

Summary of Key Findings

Descriptive characteristics of participants. I obtained an unweighted sample size of 17, 016 eligible participants after applying all specified exclusions. However, the samples were weighted, yielding a sample size of 17,576, to reflect a reliable

representation of the true population from where the sample was drawn. Hence, any observed changes in the samples could be interpreted as true changes in the factors from the population. With a mean age of 31.27 ± 8.74 years, the regional distribution of the participants was 4,190, 5,096, and 7,730 for North Central, North East, and North West, respectively. The high proportion (45.4%) of participants that was observed in North West corresponds to findings from a similar study whose authors used the 2013 NDHS (Oleribe, Kumar, Awosika-Olumo, & Taylor, 2017)

The descriptive statistics for antenatal care showed that most (73.4%) of the participants attended antenatal care for the first time in their pregnancy from the second trimester onwards, which is in nonconformance with the WHO model on antenatal care that stipulates that pregnant women should have their first contact with the person that delivers antenatal care within the first trimester (Tunçalp et al., 2017). A similar study that was conducted in Kenya also revealed that most of the women in the study did not receive antenatal care in their first trimester, mostly because of limited financial resources (Mason et al., 2015). The NDHS data set indicated that about half (46.3%) of the participants who attended antenatal care made contact with a doctor, nurse, or midwife, with only 11.2% of the proportion that attended antenatal care meeting with a health or nonhealth professional for at least eight times. This low number of antenatal care visits may be a contributory factor to poor immunization coverage in northern Nigeria because the WHO specified that a minimum of eight antenatal care visits, regardless of the location, is considered adequate for prospective mothers to receive information on perinatal and neonatal care and to have an improved maternal experience

as well as to facilitate delivery of key immunization interventions (Tunçalp et al., 2017; WHO, 2018c). Most (89.1%) of the participants received their antenatal care services from public institutions, and about half (50.7%) did not receive any tetanus injection.

The participants were between the ages of 15-49 years, with an almost similar frequency distribution across the age groups and a mean age of 31.27 ± 8.74 years. However, the highest (39.3%) proportion of the participants was between the ages of 25-34 years. Almost half (46.4%) of the participants had their first child between the ages of 16-19 years; this is an unsurprising fact because most of the girls were forced into early marriage in this region (Delprato & Akyeampong, 2017; Sinai, Anyanti, Khan, Daroda, & Oguntunde, 2017), which also explains the high population growth in this region (Fagbamigbe & Idemudia, 2016). More than half (64.3%) of this population had no form of education, reflecting their literacy level, with 72.8% of them unable to read. These findings are in concurrence with similar studies from the literature. Sinai et al. (2017) reported that about two thirds of women in Nigeria within the reproductive age were uneducated, with about three quarters completely illiterate. Similarly, for these women, most of their husbands/partners had no education. The high illiteracy rate from this population may lead to many health and social ills and may be a contributory factor to the low immunization coverage rate in this region.

For this study, only women in northern Nigeria were participants, which explains the high proportion (77.6%) of participants who practice Islam. As Obasohan (2015) explained, most people from northern Nigeria practice Islam. More than half (59.1%) of the participants were poor, and a high proportion (94.6%) were either married or in union

with a partner, suggesting that many of these women were probably housewives, or were not engaged in any form of income-generating employment. Surprisingly, majority (58.8%) of the participants were the only wives of their husbands/partners, considering that it is customary and religiously acceptable for a man in the study area to have more than one wife (Sinai et al., 2017).

Most (72.9%) of the decisions on health care were made by the husband/partners alone, with only 2.9% of the decisions on health care made by women alone, while 24.2% of the decisions on health care were taken jointly by women and their husband/partner. This finding is also not surprising because most of the women are poor and do not have the economic power to decide on health care. Male decision-making on health care is a common occurrence in this region, as men are considered leaders, bread winners, and almost complete authorities (Sinai et al., 2017).

The study findings revealed that only 27.7% of the children were immunized within 2 months of birth. Of the proportion that was immunized, there were differences in the immunization coverage for each vaccine that exceeded the recommended time. The exceeded immunization coverage was 1.8%, 6.5%, 3.9%, 7.1%, and 2.6% for OPV_0, OPV_1, DPT_0, DPT_1, and BCG, respectively. These immunizations exceeded the WHO recommended time frame of 2 months from birth for scheduled childhood immunization (National Primary Health Care Development Agency 2017; National Vaccine Advisory Committee, 2015).

Inferential statistical findings. I used inferential statistical techniques to provide answers to the research questions:

Research Question 1: Is there an association between antenatal care and uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria?

Research Question 2: Is there an association between maternal sociocultural influences and the uptake of scheduled routine immunization among infants from birth to 2 months of life in northern Nigeria?

All the variables of interest for antenatal care (timing of first antenatal care visit, person that delivered the care, number of antenatal care visits during pregnancy, number of tetanus injection received during pregnancy) except the potential covariates (respondent's checkup after delivery and baby postnatal checkup within 2 months of birth) were statistically significant ($p < 0.05$) predictors of uptake of immunization within 2 months of birth at the bivariate level of analysis.

Similarly, at the individual level, the maternal sociocultural factors (highest educational level, literacy, religion, wealth index, age of respondent at first birth, current age of respondent, current marital status, number of other wives, husband/partners educational level and person that decides on health care) except current age of respondents and the potential covariates (age of respondent at start of first marriage and respondents' rank among other wives) were statistically significant ($p < 0.05$) predictors of uptake of immunization within 2 months of birth at the bivariate level of analysis.

In the multivariate analysis to determine the strength of these associations, the model for antenatal care indicated statistical significance $\chi^2 = 213.7$, $p<0.001$. The person who delivers antenatal care, number of antenatal visits during pregnancy, and number of

tetanus injections received during pregnancy were statistically significant ($p< 0.01$; $p< 0.001$) predictors of uptake of immunization within two months of birth. Likewise, the model for socio-cultural determinants indicated statistical significance $\chi^2 = 479.35$, $p<0.001$; with the highest educational level of participant, religion, wealth index, husband/partner's educational level and person who decides on health care being statistically significant ($p< 0.01$; $p< 0.001$) predictors of uptake of immunization within two months of birth.

In this study, the different factors that may influence uptake of immunization within two months of birth in northern Nigeria were assessed and compared with previous literature.

Interpretation of the Findings

Impact of Antenatal Care on Uptake of Childhood Immunization

Antenatal care is an essential public health care service that ensures better health outcome for mothers and their babies (Abir et al., 2017). However if mothers do not access this service, they increase the risk of poor health outcome for themselves and their new born; hence attending antenatal care increases the chances that a woman obtains adequate and relevant information about routine immunization for her children (Adedokun et al., 2017). Danchin et al. (2018) explained that the decision to immunize one's child begins during the period of pregnancy. Thus, it is pertinent that pregnant women receive sufficient and relevant information on the importance of immunization during this time to enable them to make informed decision to immunize their children. To achieve this, different features of antenatal care were assessed to determine their

associations and the strength of their interactions. To determine the influence of these features of antenatal care on uptake of immunization within two months of birth, only women of reproductive age were considered for this study.

The study findings indicated that the person who delivered antenatal care, number of antenatal care visits during pregnancy and number of tetanus injections during pregnancy were reliable predictors of immunization within two months of birth in the multivariate analysis. The model considered all the variables of interest at the same time, to control for the effect of other variables while examining each variable (Frankfort-Nachmias, & Leon-Guerrero, 2015).

The study findings further indicated that women who received antenatal care from a non-health professional such as an auxiliary nurse, community extension health worker, community/village health worker and traditional birth attendant could be at a greater risk of not immunizing her new born and infants from birth up until two months of birth when compared to women who received antenatal care from a health professional such as a doctor, nurse or midwife. Another explanation is that women that received antenatal care from health professionals have higher odds of immunizing their children than women who received care from non-health professionals. This result suggests that contacts with health professionals during pregnancy has a positive impact on childhood immunization status and consequently on childhood health outcome. This may be as a result of trust and confidence in health professionals. Campbell et al. (2017) reported that parents who trusted the health advice from health professionals were more likely to immunize their children when due. However, Shrivastwa, Gillespie, Kolenic, Lepkowski, and Boulton,

(2015) provided a slightly different report that demonstrated the positive influence of antenatal care on childhood immunization. The researchers stated that although antenatal care attendance was a strong predictor of childhood immunization, however, the type of health care worker that delivers the care was not a predictor of childhood immunization. Lakew, Bekele, and Biadgilign (2015) provided a contrary opinion of the influence of the type of health care worker that delivers antenatal care to pregnant women. The authors suggested that irrespective of the health care worker delivering antenatal care, attending antenatal care was not a significant predictor of childhood immunization in Ethiopia. Hence Lakew et al. (2015) believed that attending antenatal care has no positive impact on childhood immunization. Although, there are divergent reports regarding the influence of antenatal care attendance, the findings of this study demonstrated that attending antenatal care provided by health professionals such as doctors, nurses or midwives is a statistically significant predictor of childhood immunization.

Number of antenatal care visits was also detected to be a statistically significant predictor of uptake of childhood immunization within two months of birth. Women who made at least the recommended eight contacts with an antenatal health care giver had higher odds of immunizing their children than women who made less than eight contacts during the period of their pregnancies. Phathammavong, Ali, Souksavat, Chounramany, and Kuroiwa (2010) reported that antenatal care visits improved child immunizations, underpinning the importance of antenatal care in childhood immunization. The findings of this study suggest that the WHO recommended number of antenatal care contacts is protective and increases the chances of child survival through the uptake of immunization

(WHO 2018d). This study findings concur with the report from Sullivan, Tegegn, Tessema, Galea, and Hadley (2010), which suggested that completion of the recommended number of antenatal care visits increases the odds of a child receiving immunization. Shrivastwa, et al. (2015) also reported that the number of antenatal care visits was a significant predictor of childhood immunization, demonstrating a strong protective effect for childhood vaccination.

The significance of maternal immunization against tetanus underpins its' relevance because maternal and neonatal tetanus have been discovered as one of the typical fatal outcomes of unclean deliveries and umbilical cord care (Wilson, Paterson, Jarrett, & Larson, 2015). In this study, women who received at least one shot of tetanus vaccination during pregnancy were more likely to immunize their children, compared to those who did not receive any immunization against tetanus. This finding suggests that women who receive immunization against tetanus during their pregnancies believe in the efficacy of vaccines to confer protection against preventable diseases and may likely ensure their children are immunized. Similar findings were reported by Shrivastwa, et al. (2015) in a study that was conducted in India. The authors reported that maternal tetanus toxoid vaccination was an important predictor of childhood immunization. In addition, Healy, Rench, Montesinos, Ng, and Swaim (2015) discovered that pregnant women were willing to accept vaccinations such as tetanus toxoid during pregnancy if recommended by their physician, underscoring the effect of confidence and trust in health care givers. However, Danchin et al. (2017) provided contrary evidence that uptake of vaccinations in

pregnancy is not a predictor of childhood immunization. These divergent reports may have been as a result of contextual factors and location-specific influences.

In summary, women who received antenatal care from a health professional such as a doctor, nurse or midwife, with at least one tetanus injection during pregnancy had a greater likelihood of immunizing their children within two months of birth, as compared to women who received antenatal care from non-health professional and did not receive any tetanus injection. These findings emphasize the need for the presence of health care professionals during antenatal care because the knowledge and health education they deliver may strengthen mothers' confidence in the efficacy of vaccines and reduce their hesitancy in vaccine acceptance.

Maternal Sociocultural Determinants as Predictors of Childhood Immunization

Apart from previously identified factors such as security related issues that have threatened childhood immunization in northern Nigeria, there are maternal determinants that influence uptake of vaccination. The findings of this study indicated that individual maternal factors such as education, religion and wealth index are statistically significant predictors of uptake of childhood immunization within two months of birth. From this study, it was discovered that being poor with no education and practicing Islamic or traditional religion produced less likelihood of immunizing a child. This study finding corresponds with the reports from Khan et al., (2017), which indicated that been poor with no education increases the likelihood of not immunizing a child.

Individual maternal factors that were significant predictors of childhood immunization within two months of birth in multivariate analysis included educational

level (primary, secondary and higher), Christian religion, and wealth index (middle and rich). These individual factors, as demonstrated by this study are statistically significant predictors of childhood immunization; such that Christian women who attained primary school and higher and were from middle class or rich homes had a higher chances of immunizing their children compared to poor women who practiced Islamic or traditional religion with no education.

Other variables that were hypothesized as possible predictors such as age at first birth, number of other wives and literacy lost their significance when considered together in a model after controlling for the effect of other potential determinants while examining each factor. Hence, for these individual maternal factors that lost their significance, the null hypothesis cannot be rejected. In opposition, Khan et al. (2017) reported that low literacy was found to be a significant predictor and increased the odds of immunizing a child, albeit incomplete, against Polio in Pakistan. However, the findings from my study indicated that literacy lost its' significance and may have been confounded by education.

The study findings indicated that the odds for vaccinating a child increased with an increase in maternal educational level. Similar findings was reported by Adedokun et al. (2017), indicating that the odds of a child not been immunized reduced with an increase in maternal educational level. However, although the odds for women who attained secondary education (2.05) was almost the same with those who had higher education (1.97), the highest odds for vaccination of a child were obtained with women who attained secondary education. Furthermore, the study findings support similar reports from many researchers, suggesting that higher maternal education increased the

likelihood that mothers would immunize their children, while children born to uneducated mothers were more likely to be unvaccinated (Adenike et al., 2017; Chiabi et al., 2017; Khan, Zaheer, & Shafique, 2017; van Eijk et al., 2014). This fact is not surprising because highly educated mothers may have the knowledge on the importance of immunization and so ensure that their children are immunized. Although the findings from this study concur with previous studies, which suggested that higher maternal education increases the odds of child immunization, Tsawe et al. (2015) reported contrary findings in Swaziland, that an inverse relationship existed between maternal education and child immunization, whereby the higher the maternal level of education, the lower the child immunization; such that women with primary education had higher odds of immunizing their children compared with women who had attained secondary or higher education. These conflicting results may be explained by the certain cultural, contextual and country-specific factors related to use of childhood immunization. However, precaution should be taken in the interpretation of this result because of the robust and complex analytical procedure adopted and the supporting literature that emphasize the association between maternal educational level and childhood immunization.

Wealth was also shown to influence uptake of childhood immunization. This is also not unexpected because wealthier mothers will have the capacity to immunize their children (Tsawe et al., 2015). Although childhood immunization is free in public health institutions in Nigeria, one still requires funds for indirect costs such as transportation to the health facility. The findings of this study indicated that women who are poor have a

greater likelihood of not immunizing their children compared to rich women or those from middle class homes.

Khan, Zaheer, and Shafique (2017) reported that women with no education and who were not economically empowered had higher odds of their children not receiving polio immunization or were incompletely immunized in Pakistan. Hence the authors reported that mother's education and socioeconomic status, as indicated by the wealth index were significant predictors of childhood immunization against polio. The findings of this study revealed that an increase in wealth has a positive effect on child immunization status, as rich women had the highest odds of immunizing their children than women from middle class. However, women from either middle or rich classes had higher odds of immunizing their children than poor women. Adedokun, et al. (2017) reported that children from poor households and born to poor mothers have a higher tendency to be unimmunized or incompletely immunized. This fact underscores the importance of wealth in attaining better health outcome.

Religion and ethnicity are the two most important factors that shape the behavioral pattern especially health-seeking behaviors of the people of Nigeria (Obasohan, 2015). Women that practiced Islamic religion had the same odds of immunizing their children as those that practiced traditional religion; that is to say that the practice of Islamic and traditional religions are not significantly different predictors of childhood immunization. However, Christian women have higher odds of immunizing their children when compared with women that practice traditional religion. The findings are in concurrence with the study from Shrivastwa, Gillespie, Kolenic, Lepkowski, and

Boulton, (2015) who reported that religion was a highly predictive factor of childhood immunization. The authors concluded that those children from families that practiced Islamic religion had lower chances of being immunized; suggesting that children from Muslim families had low odds of being immunized. Similarly, Antai (2009) reported that religion was significantly associated with reduced likelihood of full immunization, with mothers practicing Islam or traditional religion more likely not to immunize their children. These findings imply that women from this region who predominately practice Islamic religion may not be disposed to immunizing their children. This finding corresponds with the values obtained for children that were not immunized. Furthermore, Christian women had greater odds (5.8) of immunizing their children compared with women that practiced traditional religion, emphasizing the positive relationship between Christian religion and childhood immunization.

The role of mothers in their children's lives is well recognized; from their nutrition (Ogbo, Page, Idoko, Claudio, & Agho, 2015), physical well-being and decisions on health care. Therefore, an economically empowered and educated mother that practices Christianity was more likely to engage in child immunization, as suggested from the findings of this study.

Paternal Influence on Uptake of Childhood Immunization

Indirect influence of paternal factors was experienced in husband/partner's educational level and person who decides on health care. These factors were statistically significant predictors of childhood immunization within two months of birth in northern Nigeria.

Similar to the findings on maternal education, husband/partner's educational level followed a comparable pattern. Women whose husband/partner had no education had the highest risk of not immunizing their children. Although all levels of education (primary, secondary and higher) for husband/partner were statistically significant predictors of child immunization, the highest odds was observed for women whose husband/partner attained higher education. Thus, women whose husband/partner achieved higher education had 4.5 times greater likelihood of immunizing their children compared to women whose husband/partner had no education. This finding underscores the importance of education and suggests that attaining any level of education increases the chances of a child been immunized and consequently the possibility of a better health outcome. Similarly, this finding corroborates the reports from Lim et al., 2017; Semba et al., 2008 conducted in different settings; revealing that husband/partner educational level is a statistically significant predictor of child immunization, with higher husband/partner education increasing the likelihood of child immunization. However, Mbengue et al. (2017) provided conflicting results that husband/partner educational level was not a predictor of childhood immunization in Senegal. Although these reports are divergent, literature and evidence from the findings of this study support the hypothesis that husband/partner's education is a predictor of child immunization.

Health care decision is an important factor in health outcome, because such decision is critical to an individual's survival. Likewise, the person that decides on health care determines child immunization. The importance of this factor in child immunization is observed in reflecting the null hypothesis for this study, which posits that there is no

statistically significant difference in the person who decides on health care. However, the findings from this study indicated that joint decision-making between husband/partner and women were a statistically significant predictor of childhood immunization. This finding also suggested that there was a difference in the odds of a woman or husband/partner alone deciding on health care. The interesting finding from this analysis revealed that child immunization could only be increased by joint decision of parents. This findings concur with the suggestions from Osamor and Grady (2018) who reported a similar study in Nigeria where most of the decisions on health care were jointly taken by husbands or partners especially in North West Nigeria, with the women residing in this region less likely to make health care decisions. Similarly, Herliana and Douiri (2017) reported that children whose parents jointly decided on health care were more likely to be immunized.

Interpretation of Study Findings in the Context of Theoretical Framework

SCT is one of the most widely used frameworks in health behavior (Glanz et al., 2015), which forms the basis for many community health programs and aims to emphasize the effect of health behaviors on health practices. The principle of this theory, which is hinged on the interactions between the major constructs, defines the nature of the associations between the behavioral, personal and socio-environmental influences.

In applying the constructs of SCT to this study, behavioral and individual maternal factors such as the expectations that a child would not contact vaccine-preventable diseases and the new knowledge shared during antenatal visits as well as the confidence in health professionals and efficacy of vaccines would affect the likelihood

that their children would be immunized. Adedokun et al. (2017); and Lim et al. (2017) reported that education has a profound effect on parents' health seeking behavior for themselves and their children, such as decision on child immunization.

In addition, decision on health care may be masked by poverty for women and insufficient knowledge for husband/partner. These factors could affect health-seeking behavior and prevent or reduce the chances of child immunization.

The regional disparity for immunization coverage, with northern Nigeria producing poorer scores, could be related to the findings from this study, which revealed that most of the parents (64.3% for mothers and 53.1% for fathers) were uneducated and had higher likelihood of not immunizing their children. Hence effective use and application of the constructs of SCT, which emphasize the dissemination of health promoting practices (Glanz, et al., 2015), through the interactions between maternal behavior and the personal individual maternal factors could improve immunization coverage and possibly increase the likelihood of child immunization in this region. By these interactions, mothers could change their behavior, be more confident in the efficacy of the vaccines and the effectiveness of the health care workers delivering antenatal care, while being disposed to immunization for their children.

Limitations of the Study

For this study, a secondary data analysis was conducted using the 2013 NDHS data set. Therefore, the study findings may suffer the limitations peculiar to using secondary data, such as inadequate or incomplete information that may have been invaluable to the study and also produced inconsistency during data entry (Creswell,

2009). In addition, lack of control over the study design and processes involved in the data management of the primary study may transfer errors, if any, to this study. Furthermore, this study maybe limited by the expertise of the researchers and other professionals who collected, inputted and managed the data (Cheng & Phillips, 2014). Moreover, there are different types of bias that may affect the quality of the data collected, such as recall bias, selection bias and researcher bias (Adedokun et al., 2017a). Also, different data manipulations over the years may have also affected the quality of the data. (Cheng & Phillips, 2014).

Although a cross-sectional study typically measures association (Jacob, & Ganguli, 2016), the design has a major limitation of been unable to determine cause and effect; hence the identified associations that were observed in the study do not imply causality. In addition, with regards to the theoretical framework that was applied, a cross-sectional study cannot be used to analyze behavior over a period of time.

The information on immunization was collected for the last child of the woman within the five-year period from the previous DHS. Besides accurate identification, information bias and possible errors from recall, the estimate of the women that received some form of care during their pregnancies were considered accurate because the information provided were directly from the participants.

Only women of reproductive age (15-49 years) who reside in northern Nigeria or were visitors at the time of the survey and had complete data were considered and as such informed the sample size for the study. These exclusions may have interfered with the reliability of the sample to be truly representative (Cheng & Phillips, 2014). However,

weighting and the use of complex samples test may have improved the integrity of the samples, a major strength of this study (Kalton, & Ismael, 2003; Solon, Haider, & Wooldridge, 2015).

The study findings may not reflect the present situation in those regions because of the time gap between when the data was collected and when this study analysis was conducted.

Recommendations

Although the analysis conducted on the already existing 2013 NDHS data set was inexhaustive of the possible factors that may influence uptake of childhood immunization in northern Nigeria, the strengths, weakness and findings informed the following recommendations, which is pertinent for future research.

- To obtain an in-depth knowledge of possible factors that may influence uptake of immunization in northern Nigeria, a mixed method study that explores quantitative and qualitative approach for data collection may be invaluable because as research evolves, the strengths of both approaches would provide better insight and understanding of the research problem (Creswell, 2009).
- The use of secondary data revealed that it is truly cost and time effective, requiring the use of minimal resources to achieve the purpose for which the study was conducted, while providing evidenced-based information for decision-making. Having identified the benefit of using secondary data, it is pertinent that available secondary data sets are used to provide needed evidenced-based information that could be applied to address health issues.

- For data sets that secondary data analyses have been conducted on, more variables could be explored to exhaustively use the information provided by the participants to address their particular challenges.
- The interpretation of this study in line with the theoretical framework of choice should be undertaken more robustly. The complexity of the theory needs more demystification to improve the interpretation of the researches developed in line with its' principles (Devi et al., 2017).
- Other relevant individual maternal and antenatal care variables, which this study did not investigate, could be explored.

Implications for Professional Practice and Social Change

The findings from this study have myriad implications for professional practice and positive social change, with the potential to influence childhood immunization in northern Nigeria. The factors that were studied could provide an insight to the cause of the reported regional disparities.

Professional Practice

The study findings underline the importance of promoting immunization programs tailored to poor women with little education across religious groups, who do not effectively utilize antenatal care services.

In addition, long and short-term interventions developed with the aim to improve childhood immunizations in northern Nigeria should be encouraged from the standpoint of the community and family to ensure sustainability, and ownership, while assuring replicability in other settings. The positive influence of attending antenatal on childhood

immunization could serve as the evidence-based information required for these programs on health services such as immunization and antenatal care. These interventions, which should be undertaken with full participation of the community members, ultimately should prompt them to develop perceptions of ownership and ensure the women attend antenatal care, while the children receive the much needed immunizations within the scheduled time.

Finally, it is important that, local interventions aimed at improving uptake of child immunization should be strengthened to raise awareness on the significance of immunization and antenatal care.

Positive Social Change

There are convincing implications for positive social change from the findings of this study at different government, community and individual levels, with a focus to ameliorate the social, cultural and health issues of women in this region. The tenets of social change are to improve lives, social status and general well-being. Hence, the statistically significant findings of this study imply that child immunization depend directly on individual maternal factors such as education, wealth, religion and use of antenatal care services and indirectly on husband/partner factors such as education and decision-making power. Consequently, policies and interventions such as continued adult education and poverty alleviation that could address the inherent challenges of mothers that could prevent them from using available health services could also improve child immunization status, with a ripple effect on child health outcome and global national standing on health.

Conclusion

The reasons for which mothers would immunize their children are multi-factorial and a bit complex. Factors such as number of antenatal care visits, person that delivered care and number of tetanus immunization received during pregnancy were found to be statistically significant predictors of child immunization. Individual maternal factors such as religion, education and wealth index as well as husband/partner's educational level and person who decide on health care were also found to be significant predictors of child immunization in northern Nigeria. These findings indicate that there is an association between antenatal care and maternal sociocultural determinants of childhood immunization in northern Nigeria.

Improving child immunization coverage in this region and in the nation, Nigeria would have addressed one of the major health challenges that impede national growth and produce poor child health outcome. The hope of the nation rests on the fact that the diseases resulting from lack or inadequate utilization of immunization are preventable. Hence, all relevant health actors should advocate for re-dedication of efforts geared towards ensuring that women use the available child health-related services such as immunization.

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Appendix: DHS Authorization for Data Set Use

Feb 25, 2019

AMAKA OKAFOR
WALDEN UNIVERSITY, USA
Nigeria
Phone: 08058608009
Email: amy81ng@yahoo.com
Request Date: 02/23/2019

Dear AMAKA OKAFOR:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "ANTENATAL CARE AND MATERNAL SOCIOCULTURAL DETERMINANTS OF CHILDHOOD IMMUNIZATION IN NORTHERN NIGERIA":

Nigeria

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. Users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: archive@dhsprogram.com.

Sincerely,

Bridgette Wellington

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program